Softening of Water.

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(*Concluded from page 76*)

It is found in practice that neither by boiling nor by the lime process can all the hardness which is termed "temporary hardness" be removed; in fact, a small quantity of chalk, to the extent of 1 part in 5,000 parts, is insoluble in water, and still remains in solution after the process. In practice, however, 10-11ths of the whole of the temporary hardness may be moved by the lime process. In carrying out the Clark process, the lime-water is usually applied, owing to the fact that it is a standard liquid containing a known quantity of lime, although cream of lime is sometimes used with advantage. Large tank-space is required, to carry out the Clark process, three tanks ordinarily being required one for filling-up, another for drawing-down, and a third in reserve while cleansing is going on, and each tank should hold a day's supply.

It is a point of importance to know that the salts of iron may be readily removed by the application of lime. This the author found in the case of a waterworks at Horsham where the water was so highly charged with iron that everything it touched was discolored; but by the application of lime the whole of the iron was removed. It should also be noted that the process has a marked effect in removing organic matter from water. This was shown by the Rivers Pollution Commissioners, and by the analysis published by Professor Wanklyn, especially in the marked diminution in the amount of albuminoid ammonia. The great objection raised against soft water has been its liability to produce lead-poisoning; but the consensus of opinion is that water softened by the Clark process is not liable to attack lead, which is a point of very considerable importance is favor of the process.

Dr. Clark's process was first carried out by the Woolwich and Plumstead Waterworks Company, where it was shown that the water was successfully softened from 23° to 7°. These works were subsequently bought by the Kent Waterworks Company, and the process of softening the water was discontinued. An experiment was also made at the Chelsea Waterworks Company's works, the result of which is set forth in the following table:—

THAMES WATER AT THE CHELSEA WATERWORS.

1851	Degrees of Hardness.		Remarks.
	Before Liming	After Liming	
February 24	14 0	4 5	The river was in good condition. The mixing was completed in 10 hours
March 1	14 1	3 75	The river was in good condition. The mixing was completed in 9¾ hours.
" 18	10 5	5 0	The river was in flood, and the tinge was retained after liming.
" 22	11 6	4 8	Recovering from flood. The yellow tinge not removed.
April 17	13 5	3 6	The river in an average condition.

In the course of experiments made in softening various waters, it was observed that, if the water was at all tinted, the softening process did not clear it; but there was a tendency for the matters separated to remain in suspension in such water, so that it was considered expedient, in softening river water, that the water should be filtered until quite bright before it undergoes the softening process.

It may be here mentioned that, in 1852, a patent was applied for (W. B. Bowditch) to treat water with clay and alkali, and subsequently filtering.

Mr. Philip H. Holland, M. R. C. S., late inspector to the Burial Act Office, suggested as an addition to the Clark process the use of oxalate of ammonia or soda, to further reduce the hardness of the water after treatment by this process. The use of carbonate of soda for softening water has been known throughout the whole country by tea-makers from an early period. This salt added to water acts on the bicarbonate of lime and magnesia, and precipitates chalk and carbonate of magnesia. It also decomposes the sulphates of lime and magnesia, precipitating the lime and magnesia, while the soda remains in solution, so that the permanent hardness of the water is reduced by the use of this salt. The Rivers Pollution Commissioners of 1874 state, in their sixth report, with reference to the use of carbonate of soda, that "the hardness of water is almost exclusively caused by the presence in solution of the bicarbonates and sulphates of lime and magnesia. These salts are all decomposed by carbonate of soda, slowly in the cold, but rapidly when the water is hot, insoluble carbonates of lime and magnesia being deposited or precipitated as a fine mud, whilst soluble bicarbonate and sulphate of soda are formed." The process, however, of using soda is much more expensive than the ordinary lime process, about 4½ times as much soda being required to produce the same results as in the case of lime. An old recipe for softening water, and useful for some domestic purposes, is as follows:—Dissolve 6 lbs. of pearlash or sub-carbonate of soda in a gallon of soft water, boil the solution, and when boiling add 2 oz. of soap, and stir until all the soap is dissolved. When this solution is added to water to be softened, the carbonate of soda and the soap, combining with the salts producing both temporary and permanent hardness, form an insoluble compound by the combination with the soap, coagulates and which rises to the surface of the water, and may be skimmed off.

As any of the earthy alkaline earths may be used instead of, or in addltion to, lime, it is not surprising that, since the date of Clarke's patent, numerous patents have been taken out for softening and purifying water in which lime, in combination with other alkaline earths, has been proposed. For example:

In 1849 Mr. John Horsley took out a patent for the use of calcined caustic barytes, phosphate of soda, oxalic acid, or preparations of these substances.

In 1850 lime, in combination with chloride of barium, was patented.

In 1852 hydrate of potass and hydrates of soda, clay, and alkalies were the subject of separate patents.

In 1853 and 1854 hydrate of barytes and hydrate of strontia formed the subject of patents.

In 1855 a patent was taken out for a powder containing oxalate of ammonia, peroxide of manganese, and charcoal.

In 1856 silicate of soda, in combination with carbonate of soda, was patented.

1856 bicarbonate of soda, and oxalic acid, in crystals, were again proposed to be used.

In 1856 and 1857 carbonic acid was proposed to be introduced in conjunction with hydrate of lime.

In 1860 bicarbonate of soda and silicate of soda were again twice patented.

In 1862 the ordinary lime process was repatented.

In 1863 the use of chloride of barium was patented.

In 1865 hypermanganate of potash, carbonate of soda, alum and neutralized aluminite, or a solution of iron was proposed; and in another patent, sesqui-sulphate of alumina was proposed as a means of purifying water. In another patent taken out in 1865 the use of soda and lime is again patented.

In 1866 a patent was taken out by a Mr. J. W. Tobin for an improvement on the Clark process for mixing the lime and filtering.

In 1866 the use of chlorine and permanganates, in combination with any alkaline earth, was patented.

In 1867 a patent was taken out for a preparation in a portable form, consisting of marshmallow, linseed, bran, starch, gum, or any softening emollient, for the purpose of softening water for ablution purposes.

In 1868 the use of barytes was again patented, and the precipitate removed in vessels of a cellular form.

In 1869 the use of steam applied to water as a means of softening it was patented, the particles subsiding on shelves arranged in a vertical vessel.

In 1872 unslaked lime and sulphate of soda were patented as a means of purifying water.

In 1873 the lime process, in conjunction with a mixing and filtering arrangement, was patented; also lime, carbonate of soda, chloride of barium, or other reagent in conjunction with filtering.

In 1874 the treating of water with lime and carbonate of soda in combination with filtration was proposed.

In 1875 the lime process pure and simple, and in combination with other reagents and filtering, was patented.

In 1876 the lime process in combination with filter presses was first patented by Mr. Porter.

In 1877 the use of oxide of magnesia and basic carbonate of magnesia was proposed; also the use of a carbonate of potassa, silicate of soda, and nitre cake, used separately or combined.

In 1878 a patent was taken out for combining bicarbonate of soda with the lime process, and filtering upon the Porter-Clark plan.

In 1879 Mr. Porter took out an additional patent for carrying out automatically the softening and purifying of water. In the same year phosphoric acid and phosphate of lime were proposed as a means of softening water.

In 1880 the means of automatically carrying out the softening process, and adjusting the qualities by means of an arrangement of ball valves in a cistern, was patented

In 1881, Mr. Porter took out a further patent for the automatic regulation of the supply of the solution of lime.

In 1881 Mr. Atkins took out a patent for treating water with lime, and subsequently filtering through a specially constructed filter.

In 1882 an apparatus for softening and classifying water was proposed, in which sloping shelves in a vertical vessel were used, the water entering the bottom of the vessel and flowing off at the top; or concentric cylinders overflowing from one to another might also be used with the same object.

In 1883 Messrs. Gaillet and Huet's apparatus for softening water was patented, consisting of sloping and V-shaped shelves in a vertical vessel, the water entering at the bottom and flowing out at the top.

The use of steam and caustic soda was also patented.

A patent was also taken out for the use of phosphate of soda, and an apparatus for measuring the water and lime to be used in the softening process.

Modern Inventions for Softening Water.—The modern inventions for carrying out the Clark process may be described as the application of machinery to the saving of time, space, and labor. Of those in general use, dealing with them in the order of date, the Porter-Clark process comes first. In the ordinary Clark process, lime-water, in known quantity, is first admitted into a tank, to which the water to be softened is added. However, in some cases, the lime-water and the hard water are allowed to flow in together into the tank, but it was considered by Dr. Clark to be an advantage, in carrying out his process, for the hard water to be brought into contact with an excess of lime-water in the first instance, which was led into the tank before the water to be softened was added. In the ordinary

Clark process not less than sixteen hours were required for the softening and subsidence of the matters separated from the softened water. In the Porter Clark process, instead of allowing the particles of carbonate of lime to separate and subside, a brisk agitaton is maintained, so that these particles remain in suspension, so as to permit chemical reaction with the lime, and the purification of the hard water, which, when completed, is passed onward to filter-presses, where the carbonate of lime adheres to the filtering-cloth. The subsequent operations of filtering through the deposit on the cloth then take place, and the water is passed away at once in fit state for use, so that the process is continuous in its action, and may be carried on just as quickly as water may be pumped from a well, provided the apparatus is of sufficient capacity to allow time for the water to remain in contact with the lime in passing through the machine. The lime in this case is passed through horizontal cylinders, which are termed lime-churns and is consequently churned up with water, and the lime-water so made is, by suitable arrangements, allowed to mix with the ordinary water in proper proportions, after which it is again agitated. Mr. Porter has also an apparatus by which, instead of using ordinary filter presses, he can use filter-frames, and where power is not available, he also suggests a means of working the process without such power. In some cases the power obtained from the pressure of the water is utilized for working the apparatus. An apparatus of this description may be seen at the Camden Town locomotive-sheds of the London and North-Western Railway, and the apparatus may also be seen at work within this exhibition.

The Atkin's Process is also a modification of the Clark process, by which the space formerly required is reduced. The lime is put into a vessel where lime water is formed, and this water is allowed to mix in its proper proportion with the water to be softened in a specially arranged mixing vessel, after which it passes into a reservoir of small dimensions. From this reservoir it is conveyed to filtering vessels which contain a special arrangement of filter, consisting of a series of chambers mounted upon a central hollow shaft, these disc chambers being covered with prepared canvas, upon which the deposit of chalk, etc., adheres, and through which the softened water filters. The filters are cleansed by means of revolving brushes. The apparatus does not require power to maintain it while at work, the only power used being that necessary to give motion to the brushes when the apparatus is cleansed. The system may be seen at work at the Hemley-on-Thames Waterworks, and at other places.

In the Process of M. Maignen a powder is used which the inventor calls "Anti-calcaire." This powder is made of variable composition in order to suit the special characteristics of the water to be treated, the ingredients used for ordinary hard water being lime, soda, and alum in suitable proportions. In the apparatus, which is at work at the International Health Exhibition for softening water for some of the breeding-tanks, the water entering the apparatus gives motion to a water-wheel, which in its turn works an arrangement for distributing a given quantity of the softening agent, and causing it to pass into the water. The water is then allowed to subside in a small tank, and is eventually filtered through filters covered with asbestos cloth, the basis of the filter being similar to that of "Filtre Rapide." A part of the carbonate of lime and magnesia deposited from the water adheres to the filtering surface, and the softened water filters through it. The apparatus may be seen at work in this exhibition.

The Process of Messrs. Gillet and Huet.—In this process, which was patented in February, 1883, the patentees make use of certain known agents, the patent itself applying to the apparatus used for the purpose of producing the results after the chemicals have been applied. The agents they propose are lime and caustic soda. Whenever the water contains organic matter, they use salt of alumina or iron in addition. Iron, however, is not recommended in any case where the water is required for washing purposes. The apparatus consists, virtually, of a series of tanks in duplicate, in which the chemicals are mixed, and these enter a vertical pipe in proper proportion to the water to be softened, and which communicates with the bottom of an upright chamber divided by a series of sloping shelves, through which the water gradually works up in a zig-zag path. These shelves slope in one direction and are of V shape, so that as the deposit takes place it accumulates at one point, at which there is an opening ordinarily closed by a tap, and when any tap is open the deposit on the shelf communicating with it is washed out. The apparatus appears to be extremely simple in its design, but its efficiency has yet to be tested, although it is at work at Messrs. Duncan's, Victoria Docks.

Purification by Distilling.—It is not necessary to devote any large amount of attention to the question of purifying water by process of distillation. The process is one which has been used from remote periods in order to produce absolutely pure water, and during the last forty years very great improvements have been adopted in order to bring this process into more general application in connection with the purposes of water-supply. The difficulty of obtaining absolutely pure water is practically exemplified by this process, for in attaining this result, unless the water is distilled some two or three times, and every time a large proportion of the residue is discarded, pure water cannot be obtained. In the case, however, of water distilled for dietetic purposes, it is not necessary to carry out the process to the extent required in procuring water for some chemical purposes. It has generally been considered that distilled water lacks aeration, and on this account it has been strongly recommended that it should be filtered. The great improvements in the process of disfillation are due to Dr. Normandy, whose first patent, taken out in 1851, has been improved upon by many subsequent patents. The process has been adopted with the greatest possible advantage in many of our ocean steamers, and the preservation of the health of the crews and passengers visiting countries liable to the ravages of epidemic disease is in great measure due to the use of this process. It is generally believed by many high sanitary authorities that is this system were adopted at malarious stations, one of the largest channels by which infection is disseminated would be effectually closed. Dr. Macnamara states that on our ocean steamers, "as a general rule, condensed sea-water is employed for drinking purposes, which, although it may not be always very palatable, must obviously be free from all chance of choleraic contamination"; and this is one of the great safeguards to Europe against the spread of cholera.

Softening by Exposure.—The exposure to the air of water containing salts which are held by carbonic acid causes a loss of carbonic acid. Water of deep wells which has been in contact with chalk and other rocks often contains free carbonic acid by exposure, especially under the inequalities of diurnal temperature, the original charge of ground air is got rid of, and atmospheric air takes its place. On exposure to air, hard waters are especially liable to develop vegetable growth. A few days' exposure of very hard water in the summer-time will soon develop green confervoid growth, and so soon as this growth takes place carbonic acid is rapidly used up by it, so that the bicarbonates in the water are soon converted into simple carbonates, and are precipitated. Water, therefore, exposed to air undergoes a chemical metamorphosis; the bicarbonates of lime and magnesia are converted into carbonates and are precipitated, and it is in this way that exposure assists in softening water.

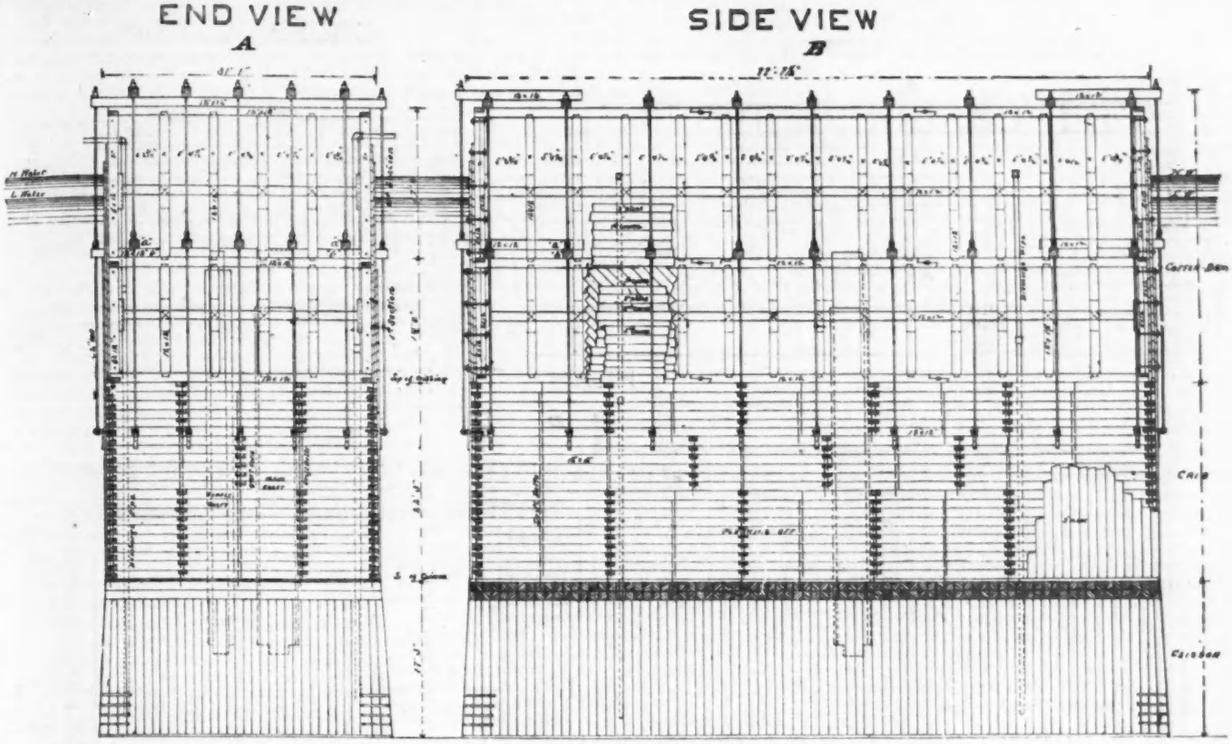
Softening by Freezing.—Pliny, speaking of the quality of water and of the controversy going on in his time amongst physicians as to the use of water, says that some people preferred rain-water above all others, because it is the lightest. He also says that some prefer "snow-water before that which cometh down in showers, and the water of ice dissolved before the other of melted snow;" and he goes on to say that the rain, snow, and ice are all lighter than those which spring out of the earth, and ice, amongst the rest, far lighter than any water in proportion. Ice taken from hard impure waters, if found to be perfectly crystalline and free from air-bubbles, will produce, on melting, a water as soft as that of distilled water. If, however, the ice contains air bubbles or cavities of any description, such water will not be entirely pure. Some years ago the author made an extensive series of experiments upon the degree of purity which might be arrived at by freezing water, when it was shown that the act of freezing may be carried to such an extent as to produce in the remaining water a precipitation of the salts in solution; but ice frozen upon very superficial water was found very liable to have the impurities frozen in it which adhered to the under-sides of the ice, and which became embedded in it by subsequent freezing, but water which has been largely deprived of air by boiling or exposure, upon being frozen, if perfectly crystalline, will produce absolutely pure water. Several patents have been taken out with a view to freezing sea-water, so as to furnish a supply of fresh water on board ship, but such processes will not compete, from an economical point of view, with the process of distillation.

Geological.—The geological formations which furnish water of a quality suitable to be softened are those of the dolomitic or magnesian limestone, which gives great hardness to water; for while salts of lime render water hard and troublesome in washing, those of magnesia cause the water to curdle, and render it considerably more disagreeable for washing and ablution. The mountain limestone, which is ordinariiy of an impermeable nature, does not yield water of such a hard quality as those of the magnesian limestone. The waters of the oolite and chalk are chiefly hard from what has been termed temporary hardness—that is, due to the presence of bicarbonates of lime and magnesia in the water, which may be got rid of by boiling, or by the lime process. The waters of the new red sandstone and permean beds vary considerably in hardness; many of them have a consider able permanent degree of hardness, but there are none of them which may not be softened to a great extent by the adoption of the lime process; while this process, in combination with the other alkali earths, such as soda, when the water is not intended to be used for dietetic and washing purposes, will still further reduce the hardness of these waters.

The surface-wells of the country, usually sunk in drift covering various geological formations, furnish water of various degrees of hardness. Scarcely any such wells yield a soft water, and in most instances, when these wells are sunk in populous places, in addition to their natural hardness, the waters are highly polluted, and such waters ought never to be used for dietetic purposes, unless they are first boiled.

DYNAMITE has recently been put to the odd use of slaughtering cattle at Islington, near London, by fastening a small charge between the horns, and immediately upon hearing of the explosion at London Bridge a New Zealand clerk, meeting the woman from whom he had just been divorced, under the pretense of salutation exploded a dynamite cartridge, blowing both their heads from their bodies.

B. & O. R. R. BRIDGE, COFFER-DAM AND CRIB.



The Caissons, Cribs and Coffer-dams of the B. & O. Bridge, Havre de Grace, Md.

BY COL. WM. M. PATTON, ENGINEER IN CHARGE.

The accompanying plans show in detail the caissons with crib and coffer-dams of Pier 4 of the Baltimore & Ohio R. R. Bridge across the Susquehanna River, at Havre de Grace, Md. The other caissons, while differing in dimensions, were identical in construction: except, that in the smaller caissons of Piers 2 and 3, the center longitudinal truss under the deck of the caisson was omitted. In these two piers there were, however, the top and bottom chords and verticals of a truss; the object of these being to give additional bearing on the material and to facilitate "blocking-up," if found necessary, thereby giving direct support to the roof of the caisson.

A description of the construction of one will answer for all. As in all structures, the simplest design, consistent with strength, stiffness, durability and economy, should be the aim of the engineer. With these conditions in view, the caissons used in this work were planned by the author after a most careful comparison and study of similar structures used in this and in other counties. An effort was made to eliminate the inconvenient and objectionable features in previous caisson constructions; how far he has succeeded in his intentions must be left to others for their judgment.

The order of description will follow that of construction. The caisson proper may be divided into two distinct parts, and answering two distinct purposes.

1st. The walls of the working chamber, or that part surrounding the open space in which the work of excavating and removing the material is carried on. These walls must withstand the pressures from without through the medium of stout-braces, and be held against pressure from within by tie-rods extending from side to side.

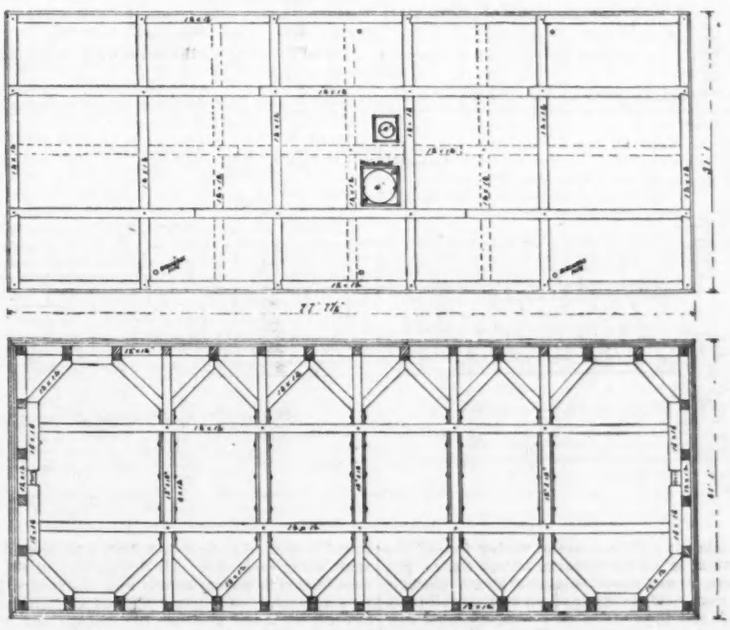
2d. The deck or roof of the caisson, resting on the side walls of the working chamber, must carry the total load of pier etc., above it; and this roof should be of sufficient strength to sustain this load without assistance from the air-pressure in the working chamber. Accidents will sometimes happen, "blow-outs" will occur, and it is frequently desirable or necessary to lower the air-pressure during the sinking process; hence the necessity for absolute and independent strength in this roof.

The connection between the roof and side walls may be made in several ways, but practically this connection is slight, the cross-section of the walls usually assuming the form of the letter "V." The detail of the present construction may be described as follows: Seven courses of timber, 12×12 inch, one lying on top of the other, (marked *a* in illustrations) formed the skeleton of the walls of the working chamber. These were first put up with a batter of ½ inch horizontal to 1 foot vertical; these timbers were not halved at the corners, but every alternate piece was carried through with a full section, "log-house" fashion. These timbers were bolted at the corners, intersections and several intermediate points with drift bolts, 1 inch square and 22 inches long. Inside of this timber shell, three courses of 3 inch plank, placed diagonally (marked *b*) were spiked to the horizontal timbers and to each other by 6 and 7 inch boat spikes. Inside of the diagonal planking was another course of 3 inch plank placed vertically with caulking seams, and well spiked, the head of each spike being wrapped with oakum to prevent leakage. The entire construction was very stiff.

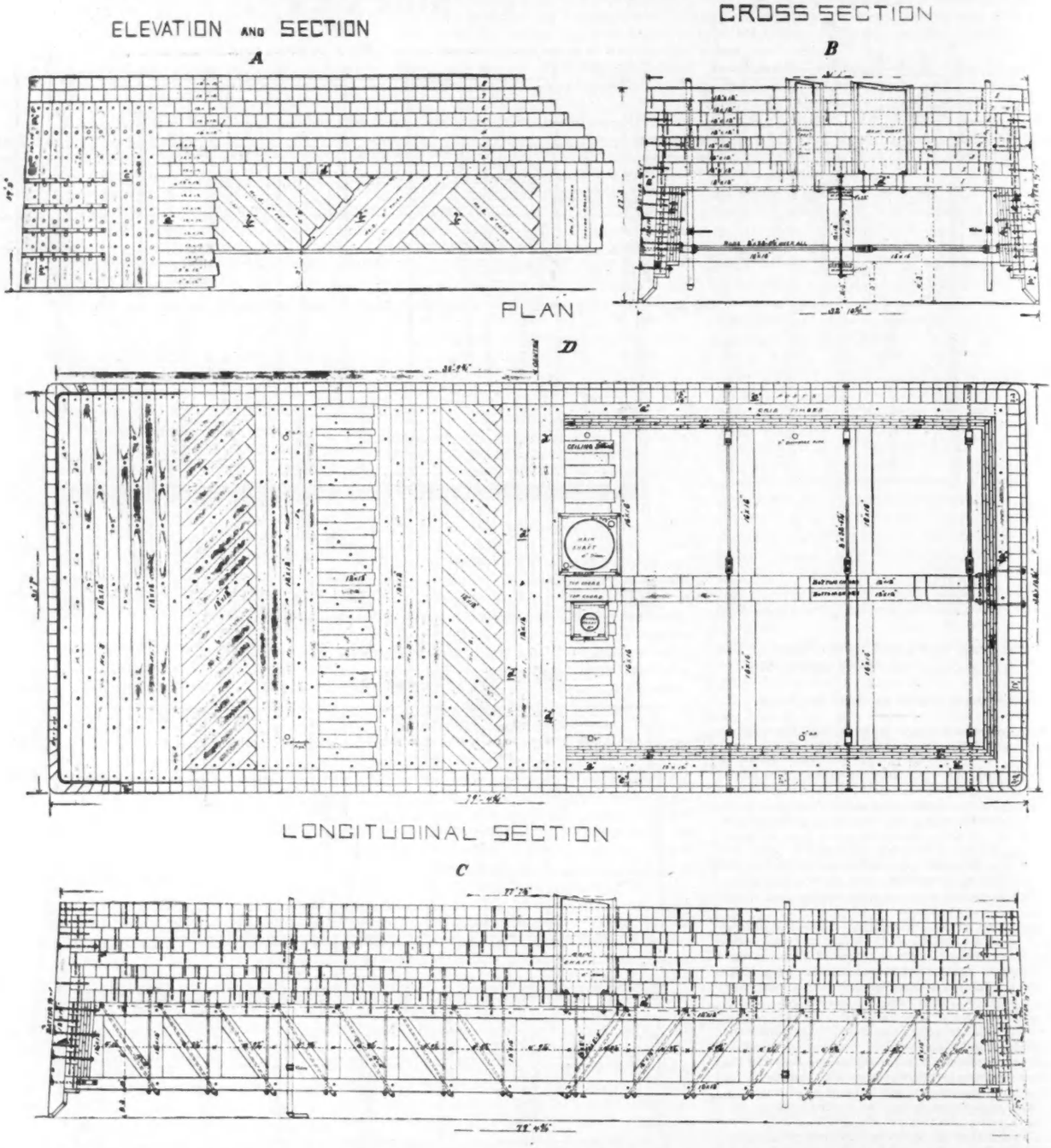
The first deck courses were now placed in position on the walls, the center longitudinal truss having been previously erected. Outside of the horizontal timbers after they had been adzed to a true surface, were then placed the 12 by 14 inch sticks, 15 feet long (marked *c*), extending 2 feet below the bottom horizontal timber with the lower ends bevelled as shown in the drawings. These outer vertical timbers extended 6 feet above the horizontal members, and had a 2 inch shoulder cut on their inside faces, 3 feet from the top. All spikes and drift bolts were arranged so as not to interfere with the through bolts. Four screw bolts were passed through each outside post and through the entire wall; and, in addition to these, two drift bolts, 1 inch square and 30 inches long, in each vertical served to more thoroughly bind the wall together. This compound of timber and planking formed the walls of the working chamber. After the first deck course was on, a few pieces of the second course were laid diagonally to give it stiffness; the underside of this deck or roof was then lined with plank and thoroughly caulked, and a false bottom put into the working chamber preparatory to launching it.

After the caisson was launched, the decking course

PLANS



B. & O. R. R. BRIDGE. CAISSON.



were completed; eight courses of timber formed the finished deck in all the caissons except No. 9. The first course *d* was made of single length timbers, reaching from inside to inside of the vertical wall posts mentioned, and thus rested on top of the horizontal timbers and inside planking and the top chord of the central truss; it was bolted to these members by 22 inch drift bolts. The second course was laid diagonally and was made of varying lengths of timbers. The third course was laid from side to side across the caisson and the fourth course longitudinally and resting on the shoulders in the 12×14 inch verticals. The fifth course was laid across, the sixth, diagonally—crossing the second course—and the seventh and eighth courses extended to the extreme outside limits of the caisson and rested on the heads of the vertical posts. In No. 9 caisson two more courses were added to these named. This general arrangement of the top courses, resting as they did on the heads of the outside verticals and the shoulder in these verticals, gave a direct bearing on the posts and relieved the wall bolts of a great shearing strain to which they would otherwise have been subjected.

The outside posts were bolted to the deck courses by one 3 feet screw bolt and two drift bolts, 30 inches long, fastening them to the longitudinal and diagonal courses respectively. The several deck courses were bolted to each other by 22 inch drift bolts, spaced 5 feet apart along each stick. All the timbers in the deck were bedded in cement mortar and the vertical joints were grouted, so as to give a full and uniform bearing for each stick, and decrease the leakage and danger from fire. The center truss was constructed to bear a uniformly distributed load, as an ordinary Howe truss, or to act as a cantilever. It was composed of a top and bottom chord, each made of two 12×12 inch sticks, with posts and diagonals of wood and vertical and diagonal tie-rods of iron, 1¼ inch in diameter; the iron vertical rods extended through the first deck courses, and the top chord was also bolted to the deck with drift bolts. The object of this was to enable the truss to act as a stiffening rib to the deck, independently of its action as a girder to bear a load. The bottom chord was also extended to the ends, and by means of straps and bolts, acted both as a strut and tie-brace for the ends of the caisson, and contributed the only end bracing, except in the case of No. 9 caisson, where additional end bracing was added.

The sides of the caissons were braced against outside pressures, by 16×16 inch timbers abutting against the walls and bottom chord of the center truss, and against pressure from the inside, by 2 inch iron tie-rods extending from out to out of the caisson. All the timber used, except the planking and outside posts and the bracing in the working chamber, was 12×12 inch. Iron straps, extending 6 feet on the sides and ends, were placed at the corners and bolted to the caisson timbers; these straps were made of bar-iron 3×1 inch and prevented spreading of the walls of the caisson under excessive pressure from within. Planks were spiked to the lower part of the posts, and a narrow plank was also spiked under the bottom of the posts, and was called the shoe.

From the foregoing description it will be seen that the caisson construction was simple and strong, no slight consideration in the encouragement of men working under what might otherwise be dangerous conditions. The working chamber was surrounded by a solid wall of timber, 14 inches thick, firmly connected to the deck; with the horizontal timbers acting as distributors of stress and, with the four layers of 3 inch plank, further strengthening the walls and serving as brackets to support the roof. There was, in no case, the slightest inward bending or springing of walls, even when No. 9 caisson, owing to the too rapidly escaping air, came down so hard upon the rock at one end as to crush off the bottom of the posts. The departure from the ordinary V-shaped cutting edge, and the substitution of square shoulders arranged to give the same effect, seemed to promise many advantages, enabling the engineers to better regulate the sinking of

the caisson by giving a largely increased bearing surface. With this ample support the material could be cleaned out from under one side or end; the caisson could be levelled, and, if the material was softer in one spot than another, the caisson could be prevented from tipping. It further afforded a good surface for blocking up when it was found desirable to support the caisson on a concrete wall, and during the removal of the material; it gave also greater security in case of a "blow-out" or the failure of air-pressure. With any other form of cutting edge, the author does not believe that it would have been possible to securely found a caisson upon a rock bottom varying 17 feet in level in the cross section of the foundation as was the case in one of these piers.

Above the deck of the caissons came a cribwork made of 12 × 12 inch timbers, and varying in height from 22 feet to 42 feet according to the depth of bottom material at the several piers. The original intention was to commence the masonry at the bed of the river, so as to materially reduce the obstruction to the current, and consequent scour, and also to avoid any possible danger from abrasion of the timber or concrete during the exceeding heavy flow of ice following the breaking of the great ice-gorges formed nearly every winter. A simple crib of timbers crossing each other forms a strong structure, but it cuts up the concrete and prevents the construction of the monolithic mass, which is the chief advantage claimed by the advocates of concrete foundations. Another objection to an ordinary concrete filled crib was the difficulty in making an ordinary laborer realize the very great importance of solidly filling under and around so many timbers. If the timber walls were made solid from top to bottom, the concrete would have been divided into isolated columns, and this was again objectionably.

The plan finally adopted here and shown in the drawings was as follows:—The cross and longitudinal walls were brought up solid, say for 10 feet, then these walls were shifted to the middle of the pockets below, and again brought up solid for a distance depending on the height of the crib; and then shifting them back vertically over the first, or bottom walls, and so on to the top of the crib. By this arrangement the trouble from careless workmanship was avoided and the bond of the concrete was not broken. The timbers forming the crib were bolted to each other by 22 inch drift bolts, spaced 5 or 6 feet apart, and they were dove-tailed at the corners and connections. The whole crib was sheeted on the outside with 3 inch plank. A strong box was thus formed to hold the concrete which was thoroughly rammed; and it was also possible to go on building concrete on concrete or masonry on concrete, without having to wait for more than an initial set in this concrete. In no case was there any delay from waiting for the concrete to set before adding weight; the additional weight was of course put on gradually at ordinary building rates.

The bottom walls, both longitudinal and transverse, being firmly bolted to the deck of the caisson, acted also as strong built beams, greatly increasing the strength and stiffness of the caisson deck under its immense superincumbent load.

As soon as the crib was completed, and without necessarily waiting for the completion of the concrete filling, it was surmounted in all cases, except in Pier No. 2, with an open caisson or coffer-dam. By this dam the water could be kept out until the masonry was built to a point above high tide. In the case of Pier No. 2, the masonry was built while the pier was sinking and thus kept above the water-line; but this method was attended with delay and inconvenience, as it was necessary to regulate the rate of sinking by the speed with which the masonry could be built; and further, it was absolutely necessary to go on with the masonry whether additonal weight was needed or not in sinking the caisson.

The plan of coffer-dam adopted and shown was as follows:—Uprights were first placed at intervals of about 5½ feet, connected by mortise and tenon to caps and sills, and held down to the crib by rods, 2 inches in diameter, with hooks at one end passing into eye-bolts in the crib. The top of these rods passed through 12 × 12 inch timbers resting on the sides of the dam and projecting about 2 feet outside. The end rods passed through short pieces, called "look-outs," which were bolted to one of the cross timbers and projected beyond the ends of the dam. The corner posts were made of two pieces 6 × 12 inches bolted together, and the entire outside was covered with 3 inch plank. The planks on the ends were spiked to one of the corner pieces and those on the sides to the other. The joint between the coffer-dam and the crib as well as the entire outside sheeting was well caulked. The bracing, shown in the illustration, was put in as the caisson went down. The bracing was so designed as to give ample support to the sides of the caissons and at the same time to interfere as little as possible with the construction of the masonry. As the masonry was built up the sides and ends of the coffer-dam were supported by blocks abutting against the masonry. When the masonry was completed, the coffer-dam was removed by taking out the bolts in the corner posts, and disconnecting the vertical rods. At Piers 4, 8 and 9, the coffer-dam was built in sections, owing to the great height required, and the outside rods were also made in sections with swivel connections, the swivel taking the place of a nut for the first or bottom section.

When the top section of the dam was put on the cross pieces and the "look-outs" were sawed off. The bottom section was sheeted with three thickness of 3 inch plank, the top section with two thickness.

These dams served excellently the purpose for which they were intended; they were easily framed and erected and readily removed in the end.

The concrete used in filling the cribs was composed of cement, sand and broken stone. In piers Nos. 2, 3 and 8, the cement used was mainly Alsen's Portland; in Nos. 2 and 8, the proportions were, cement one part, sand two parts; in No. 3, cement one part, sand three parts. Some English Portland and some American Portland, Sayler's was used; the Alsen brand, however, gave more satisfaction. In the cribs of piers 4 and 9, the concrete was made with F. O. Norton's cement, a most excellent article. The proportion was one cement, two sand. Generally, one yard of concrete was made from one barrel of cement; using 3 to 1, 1⅛ yards of concrete to one barrel of cement. By actual experiment, a cubic yard of the broken stone (used on this work) was required to make a cubic yard of concrete. The quantity of cement required would vary materially with the character of the stone employed; if broken by hand or screened of the smaller particles, a large quantity of cement was required.

Satisfied in the early stage of the work, that an attempt to use an exact proportion of stone would necessarily lead to great waste of time, and not produce any better results, it was determined to simply proportion the broken stone by a uniform rate of shovelling. The object in view was to have a sufficiency of paste to make an absolutely solid mass. The result was not absolutely uniform, but was good and certain, and in practice the stone was delivered to the mixer with surprising uniformity by the shovels. If the stone varied in size or in quantity of smaller material, the delivery was regulated by altering the running of the machinery; this answered a better purpose than changing the rate at which the men were shovelling.

The proportions of the concrete were one part cement, two parts sand, and five parts broken stone. The sand and cement were, however, carefully proportioned and mixed by the Sooysmith Concrete Mixer, described in ENGINEERING NEWS, of Dec. 6th. This mixing of the mortar was considered of paramount importance. As to the quantity of water used, the object was to avoid the extremes of either a very wet or a very dry mixture; the first would have produced a spongy, porous mass, difficult to ram, and long in setting; and the second, while seemingly the most correct in principle, would be found very difficult to thoroughly incorporate and distribute the stone. In an experiment carefully made with dry concrete, after the lapse of three days, the mass was found to be practically unchanged, with broken stone scattered about in a dry powder, which was easily picked out. But by using just sufficient water to produce a plastic mass, allowing a partial floating of the stone when rammed, and a skin of moisture on the surface, a very satisfactory result was obtained, and the proportions used in this work were adopted. Large stones, such as could be handled by one man, were bedded in mortar as the successive layers of concrete were formed, and over and around these another layer of concrete was rammed.

The stone for the concrete was broken by a Gates' Crusher, which gave very satisfactory results. At first, the stone from the crusher passed over a screen, by which the bulk of the dust and the smaller particles were removed. But experience satisfied the engineer that he was thus removing a very valuable part of the material and the screening was abandoned, and the stone used as it came from the crusher. As a rule, the concrete was carried in barrows from the mixture and deposited in place; no avoidable disturbance of this mass was permitted. Where the fall was considerable, or where timbers interfered, the concrete was passed down in shoots, which were cut off as the concrete was built up. Water was kept down below the concrete surface by pumping, for at least twenty-four hours after it was placed.

The specifications admitted stone that would pass through a 3 inch ring, but experience here on a large scale convinced the author that no stone should be larger than 2 inches on a side, and the smaller the stone the better. The large bulk of the stone used here fall within the latter limit.

In all the caissons the crib was caulked, except in Caisson No. 2, where the smaller depth of water and the great depth of mud enabled the concrete to be kept well above water during the filling. In Caissons 3, 8 and 9, a bed of Portland cement mortar from 3 inch to 1 foot thick, was first placed immediately over the deck of the caisson; this was mixed one to one. The object of this was to prevent air and water from entering the crib from below, an end not always thus attained, however, and in Caisson No. 4, a layer of 3 inch plank, well spiked to the deck and caulked, was substituted for the mortar with excellent results.

The dimensions of the several caissons were as follows:—

Caisson No. 2, top 61 ft. 6 in. × 24 ft. 2 in.; bottom, 68 ft. 3¼ in. × 25 ft. 11¼ in. Caisson No. 3, top 61 ft. 6 in. + 21 ft. 2 in.; bottom, 67 ft. 3¼ in. × 25 ft. 11¼ in. Caisson No. 4, top 77 ft. 7½ in. × 31 ft. 1 in.; bottom, 79 ft. 4¾ in. × 32 ft. 10¼ in. Caisson No. 8, top 69 ft. 1 in. × 30 ft. 10 in.; bottom, 70 ft. 10¼ in. × 32 ft. 7 ¼. Caisson No. 9, top 76 ft. 5 in. × 40 ft. 6 in.; bottom, 78 ft. 2¾ in. × 42 ft. 3¼ in.

All caissons were 17 feet 3 inches high from bottom of shoe, except No. 9, which was 19 feet 3 inches high. The working chamber was 9 feet 3 inches high from bottom of shoe to underside of deck; this was higher than required for working but was adopted so as to permit a proper proportion in depth to length of the central truss. In the original design it was intended to protect the cutting edge with iron, but the borings indicated no material requiring this precaution and it was omitted. The author's experience on this work convince him that under no circumstances is an iron shoe either advantageous or necessary. At this work, the caissons came down on boulders, and were carried for a considerable distance into a compact mass of large and small boulders, without serious, or, in fact, any injury. No. 9 caisson struck hard on the rock, with an immense load upon it, and unsupported by the compressed air; the only damage resulting from this severe test was the crushing of the plank shoe and the bottom of the posts, which in no wise effected the integrity of the caisson and could easily have been repaired if thought necessary. Other caissons rested hard upon rock at one or more points, with a slight crushing of the shoe as a result.

Blasting was resorted to in this work on a larger scale than upon any work with which the author is acquainted. Powder and dynamite were both used without any damage at all. The caissons were not suspended by rods, bolts or trussés from above as is often done under similar circumstances; and although they were sunk through great depths of solid material they were guided down to the river bed and sustained by the manipulation of the air-pressure, by methods and manners to be discussed in a further article.

The manner of sinking the caissons, the daily rate of progress and the difficulties met and overcome are interesting and important, but will also enter into another article.

Explanation of Illustrations.

"*A*," *Caisson Proper;* Part elevation, part section. The Elevation shows outside posts, 12 × 14 inches by 15 feet.; the connection of the same with deck of caisson, and number and kind of bolts used and the corner straps. The section shows deck of caisson: horizontal lining, and arrangement of diagonal and vertical lining plank.

"*B*," *Cross Section* of caisson shows: arrangements of deck courses; outside posts: horizontal lining; lining plank; form of cutting edge; lateral rods and strut braces, in the air-chamber; end view of longitudinal truss; arrangement and position of screw and drift bolts, and also position and dimensions of main or air-shaft; supply shaft and discharge pipes.

"*C*," *Longitudinal Section*, showing same as "*B*," with side view of central truss and connections.

"*D*," *Horizontal Section* of caisson; top view and plan.

CRIBBING AND COFFER-DAM.

"*A*," *End View of Caisson* surmounted by crib and open caisson or coffer-dam, with outside sheeting plank removed. Pieces marked *a* and *b* are sawed off after posts and vertical rods for the top section are put in place.

"*B*," *Side View* of same, partly covered with sheeting plank.

"*C*," *Plan and Horizontal Sections* of crib, with the alternating position of the longitudinal and cross ties.

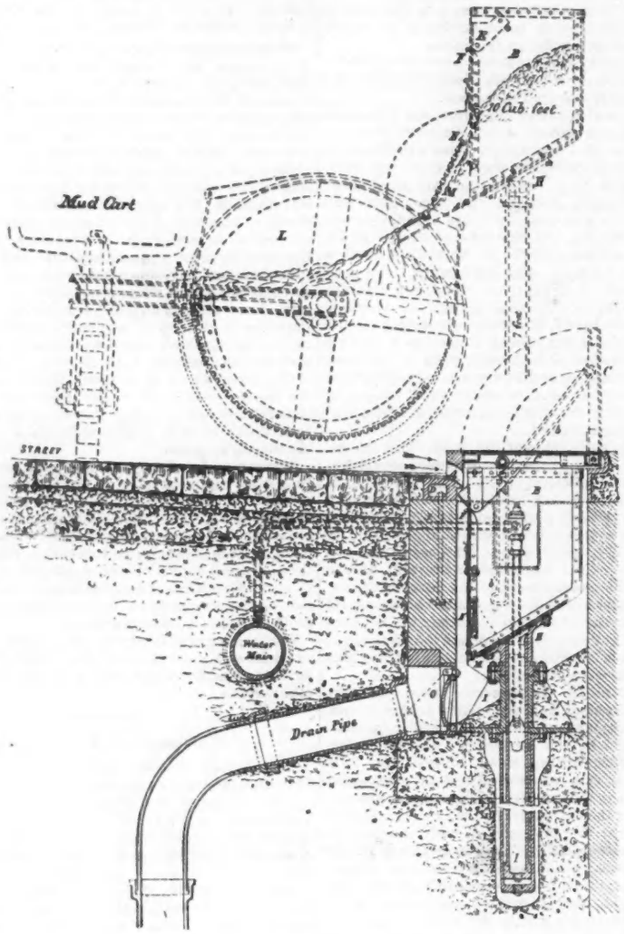
"*D*," *Plan of Coffer-dam* and system of bracing adopted.

THERE are in America at the present time 30,000 locomotives. To keep up the standard and supply new demands, 1200 must be built each year. Locomotives cost on an average $10,000 each, which would indicate an expenditure of $12,000,000 this year. There are sixteen locomotive works in the United States, among whom this work and money will be more or less evenly distributed.

RHENISH railway companies are liable to the Government for military fees and conscriptions, to partly relieve which one company built last year two monitors, which it stationed at Cologne, but in their construction the water level and the currents and eddies of the river were not taken into account, and they had to be abandoned. The boats, which cost $225,000, have just been sold for $1700.

ENGINEERING NEWS for three months One Dollar.

POWELL'S MUD RECEIVER AND HYDRAULIC LIFT.



Powell's Mud Receiver and Hydraulic Lift.

We illustrate above a new form of movable and self-emptying street mud-bin which has recently been introduced by Mr. William Booth Powell, of Tintern-street, Brixton, and Whitehall-place, London. The arrangement is very simple, and consists of an iron or steel receptacle which is attached directly to a hydraulic ram, as shown. The ram is worked by the pressure in the water company's main and lifts the receiver sufficiently high to command the scavenger's cart. A door is then opened at the side and the contents fall by gravity into the cart, sliding along the sloping bottom of the cage; or if required the latter can be tilted on trunnions. The waste water from the hydraulic cylinder is used for flushing the pit in which the receiver is placed. The way in which the ram is guided in the case is very simple. A V-shaped guide is cast on to the interior of the case, and this fits a corresponding notch in the ram, the latter being swelled at the end nearly as large as the case, and so proves at the same time a stop by coming in contact with the top box.

Our present method of removing street refuse or domestic garbage is offensive and uncleanly, so that any practical improvement by which the operation could be performed should receive every attention.—London *Engineering.*

TUNNEL UNDER THE STRAITS OF MESSINA.—Signor Giordano, engineer, has begun the preparatory works for connecting Italy and Sicily by submarine tunnel.

BALTIMORE'S city debt is $37,541,751.73. It owns Baltimore and Ohio Railway stock to the value of $5,416,000 on which it realizes handsome dividends.

Large German Lead Works.

From a recent number of London *Engineering* the following particulars are gathered relating to the works of the Mechernich Lead Company, situated at Mechernich, in the Eifel district, Germany. These works, which are one of the most extensive mining and smelting establishments in Europe, turn out yearly over 25,000 tons of refined lead, being very much more than is produced by any other single works. But it is not the large amount of metal turned out which gives interest to these works; it is the very low-grade material from which the lead is obtained, and the great bulk of rock which has to be handled in order to reach the above produce. This rock it a soft sandstone, in which is disseminated galena in fine grains and crystals. There are a few nodules of ore of larger size, and besides the galena there occur also small quantities of carbonate and molybdate of lead; but these are quite insignificant by comparison, practically the whole of the metal occurring as galena na finely sprinkled through the light yellowish sandstone. The great amount of this sandstone that has to be worked may be judged from the fact that the usual average assay of the rock, as it goes to the dressing works, does not exceed 3 per cent. of lead. Latterly, owing to the very low price of lead, it is understood that some of the lowest grade parts of the workings are being left, so that the average of the stone raised may assay a little higher, but with anything like a normal lead price 2½ to 3 per cent. stone is worked. The property of the company extends for some 2 miles or so along a low ridge, which forms the outcrop of the lead-bearing sandstone, which dips toward the north.

The working is carried on partly by quarrying and partly by mining, there being two main points of operations some distance apart, with a quarry and a mine at each point, the rock being got by open workings as far as the dip will allow, and then followed by mining. The quarries are on an enormous scale, working on many terraces with lines of tramway at several different levels. The blasting is carried on by means of electric shot-firing from a central station, and recently electric lighting has been successfully introduced for night working. A layer of red sandstone several yards in thickness has to be removed before coming to the lead-bearing yellow sandstone, and huge waste heaps are being pushed out into the surrounding country from the several dumping points to where this red sandstone is taken. The yellow sandstone, as quarried, is hauled away to the mouth of the neighboring mine, right over which are erected the dressing works in a building many stories high, each story smaller in area than the one below it, till the final one is just large enough for the ascending trucks of ore to be emptied out above the stone breakers, through which it is at once passed. The ore from the quarry and that from the mine are raised to this top story and then pass down through a series of crushers, classifying cylinders, revolving sorting tables, etc., being deprived during the passage of a large amount of pebbles of all sizes, which contain no lead, and of pieces of worthless sandstone. The whole is finally reduced to powder and subjected to hydraulic dressing and concentration.

The mechanical arrangements are very perfect, the great mass of material passing down through the several stories, and from one stage of the process to another, with a minimum of manual labor. The final result of this dressing of the ore is, that a portion of it is concentrated to 60 per cent. of lead, and goes direct to the smelting works, while another portion reaches only about 20 per cent. of lead, and is taken away to another central dressing works, at which, together with a similar product from the other quarry and mine, it is further treated, and eventually also concentrated to 60 per cent. lead and sent to the smelting works. The ore, as delivered to the smelting works, is very pure indeed, and the working of it is very simple. It is calcined and agglomerated in large "double-decked" furnaces, and is then smelted down in blast furnaces, with lime-stone and iron ore as fluxes, yielding a very soft lead, containing a little over 7 ounces of silver per ton. The lead is desilverized by the zinc process. The company employ over 4,000 workmen, and have in use 25 full-sized locomotives on 12 miles of railway. They have erected large stores for supplying necessaries to the men; also flour mills, bakehouses, and a large brewery, everything being sold at cost price to employees of the works.

In spite of the "bad times," which have fallen, perhaps, more severely on the lead trade than on any other metallurgical industry, this company continues to pay a large dividend on its capital. There are some other works in the district operating on the same class of material, but they are comparatively small and unimportant. Water is scarce and has to be economized. At the large dressing works above described, elaborate arrangements are made for using it over and over again. The final residue of sand from the crushed sandstone is pumped out with the water from the last stage of the dressing process into settling tanks outside the buildings. The water, after cleaning, is used again, and the sand hauled on to large waste-heaps.

PAVED WITH BRICKS.—The town of Charlestown, W. Va., is the only American city paved with bricks in the middle of the streets—bricks turned endwise and set on wood. They last well, and have been known 200 years in Holland.—Buffalo *Commercial:*

Geological Maps.

Part first of division first of the grand atlas of the second geological survey of Pennsylvania has just been issued. It contains fifty-six county maps, printed on sheets twenty-six by thirty-two inches. This size is so large that the atlas will prove awkward and cumbersome for popular use. The scale employed is usually two miles to an inch. The atlas is put forth with the caution that the maps are based upon those published privately by engineers and surveyors independently for each county, that none of them are correct, and that they can rarely be joined together so as to form a connected whole.

A geological map is nothing more than a topographical map upon which colors are spread to indicate the different rock formations which appear upon the surface. The value of the map will usually be measured more by the excellency of its topography than by the accuracy of its geology. The farmer who uses the map will need to have the common roads and villages carefully shown. The engineer needs contour curves if he is to use the map for the location of roads or the designing of a water supply. The geologist needs the best possible representation of the topography of the country in order to trace out the structure of the hills or to search for mineral wealth, and so does the scientist who endeavors to reason back into the past and discover how the rocks were made in such wondrous fashon.

On these county maps are represented, besides the colors, the streams, the common roads, the railroads, the principal towns and villages, and the boundary lines of the townships. No representation whatever is given of hills and mountains, so that the only method of judging of elevations is by means of the rule that the streams run down hill and that they occupy the lowest part of their valleys. From an engineer's point of view the maps are hence very defective, and it does not appear how they could prove of great value to a geologist unacquainted with the country.

In preparing a map for publication the aim should be, we think, to put upon it all possible information likely to prove useful to those who are to use it. It cannot be expected that everything should be mathematically exact, for this is only possible when a great expense is incurred for surveys. But in a state like Pennsylvania it is possible to compile from the older maps some information regarding the higher hills and mountain ranges which would be useful in connection with the geology. For instance we have in mind a map of Luzerne County, by Schooley, published at New York in 1864 which represents the mountains by hachures and gives the elevations of many points above the level of the Susquehanna at Wilkesbarre. It appears to us that something of this kind, even if more or less imperfect, would have greatly added to the value of the county geological maps.

Many of the detailed topographical maps of the Pennsylvania geological survey, published in its octavo reports, are of a very thorough character, and show the hypsometry by means of ten foot contours. It is greatly to be regretted that such surveys could not have been extended over the whole State so that the geology of the counties might have been laid down upon a satisfactory topographical basis. But State legislatures do not understand the necessity and value of contour curves and are unwilling to appropriate money for such purposes. Undoubtedly the time will come, however, and we trust it is not far distant, when it will be clearly appreciated that all geological and economic surveys must be preceeded by the construction of detailed topographical maps.

ENGINEERING NEWS Three months for One Dollar.

OUR MATHEMATICAL COLUMN.

THE NUMBERS 123,458,769 and 967,854,321 are curious ones. Each contains all the nine digits once and but once, and the order of the digits in the second is exactly the reverse of that in the first. The first number is the product of the factors 11,313 and 10,913. The second number is the product of the factors 31,311 and 31,901, which are also the reverse of those of the first number.

MANY MYSTERIES and truths are claimed to lie concealed in the great pyramid of Egypt. For instance the base of the Naperian system of logarithms can be derived from the dimensions of the king's chamber and the coffer. The width of the former is 206.3 inches or 10 cubits, and that of the latter 38.65 inches or 1.87 cubits. Now if we write the equation, 10 with an unknown exponent x equals 1.87, and then compute the value of x, we are pleased and surprised to find that it is 0.2718. This is one-tenth of the base of the natural system of logarithms which was unknown to science until discovered in 1614 by the genius of Napier.

THE ALMANAC for February contains nothing of exciting interest. Early in the evening the planet Saturn may be seen high in the southern sky in the constellation Taurus. In the southeast is Sirius, the dog star, and Procyon, the little dog, both brilliant and twinkling. But the brightest object in the sky is the planet Jupiter which rises at 7 P.M. a little north of east. Jupiter is now nearer the earth than at any other time this year, and his four moons may easily be distinguished with a small glass. The length of the day increases during the month about one hour and five minutes. As the days slowly lengthen a slow but sure improvement in business interests is expected. There are two semi-holidays, Friday the 14th, and Monday the 23d. The latter we gladly celebrate, for Washington was a good surveyor and engineer.

ALGEBRA has been defined as the science of pure time, and there are a great number of possible algebraic systems. Benjamin Peirce, the distinguished American mathematician, undertook the investigation of all possible algebras up to the sixth order and discovered one hundred and sixty-two different systems. The algebra of quaternions seems to be the only one, besides the common algebra, that has been developed to any extent. To investigate the possibilities of the different triple, quadruple and quintiple algebras would be a great task, for which life is too short.

CURVE TRACING is the title of a neat little work by Professor W. W. Johnson of the U. S. Naval Academy which has recently appeared from the press. The book does not treat so much of the plotting of curves, as of the discussion of the equations of curves, the determinations of asymtotes, tangents, singular points, cusps, and other properties not without value in actual plotting. For this purpose a very ingenious device called the analytical triangle is introduced, which greatly simplifies the discussion. This triangle is nothing more than the representation in co-ordinates of each term of an equation by a point, the abscissa of that point being the exponent of x in that term and the ordinate the exponent of y. If these points be joined by straight lines an analytical polygon results which indicates at once many properties of the curve. The author does not insist upon the importance of actually tracing the curves upon cross-section paper. This is strongly recommended by Phillips and Beebe, and seems to be the only way in which students can attain a comprehensive grasp of the subject, although they cannot of course plot the points and lines at or near infinity. The imaginary branches of the curve may, however, be plotted for the most usual cases, and are of great value in clearly illustrating the subject of imaginary roots.

PROBLEM 1. The perimeter of a triangle is 24 feet, the radius of the inscribed circle 2 feet and that of the circumscribed circle 5 feet. What are the three sides?

Solutions of this problem have been received from M. A. R., Ann Arbor, Mich., and N. Shiraishi, Philadelphia. Let x, y and z be the three unknown sides. Then the sum of these quantities is 24. The area of the triangle expressed in terms of x, y and z is also equal to 24. The product of the three unknown's is equal to double the product of the perimeter, and the two given radii. Thus we have three equations containing three unknown quantities whose solution gives the values of the sides as 6, 8 and 10.

PROBLEM 2. A clean cast-iron pipe 2 inches in diameter and 1200 feet long delivers water from a reservoir under a head of 230 feet. What is the horse power of the issuing stream?

N. Shiraishi, Philadelphia, sends the following solution. The velocity in a long pipe by Weisbachs formula is given by the expression

$$v^2 = \frac{100\, g\, d\, h}{l}$$

in which d is the diameter, l the length, h the head and g the acceleration of gravity. From this the value of the velocity v is found to be 10.1 feet per second. This is equivalent to the velocity required by a body falling a distance of 1.6 feet. The weight of water issuing per minute from the orifice its equal to its area in square feet into the velocity 10.1, into 60 seconds, into 62.5 pounds, which is found to be 825 pounds. Then we have

$$H = \frac{825 \times 1.6}{33000} = \frac{1}{25}$$

and this is the horse power of the issuing stream.

PROBLEM 3. Prove that the most economical depth of a bridge truss with parallel chords is that for which the quantity of material in the chords is approximately equal to the quantity in the webbing.

No solution of this problem has been received and hence we submit the following to the criticism of our readers. The stresses in the chords are obtained by dividing certain moments by the depth of the truss, and as the quantity of material is approximately proportional to the stresses it must vary inversely as the depth, or as $\frac{A}{d}$ in which A is a constant independent of the depth d. The stresses in the webbing are obtained from certain shearing forces which are not related to the depth and hence the quantity of material in the webbing increases approximately with the length of the pieces or with the depth so that this quantity varies as $B\,d$, in which B is a constant. The total quantity of material therefore varies as

$$\frac{A}{d} + Bd$$

and evidently the most economical depth will be that which renders this expression the smallest, or a minimum. It is easy to show that this occurs when d^2 equals A divided by B, or when.

$$\frac{A}{d} = Bd$$

that is, the value of d which renders the quantity of material a minimum is when the quantity in the chords is equal to that in the webbing.

This demonstration is only approximately correct because it leaves out of sight the variability of the section of long struts with their length, which variation depends upon the depth d in the case of web posts.

PROBLEM 4. (Proposed by T. J. L., New York). Let $A\,B\,C$ be the base and D the vertex of a triangular pyramid, all of whose linear dimensions are known. What is the vertical distance of D above the plans of $A\,BC$?

PROBLEM 5. A ship weighing 4,500,000 pounds moving with a velocity of one foot per minute, strikes the gate of a canal lock. The gate can slowly yield under the pressure a distance of six inches but no more. If the gate can stop the ship, find the number of pounds pressure against it.

SELECTED MISCELLANY.

SOME English capitalists are forming a syndicate to bore on a large scale for petroleum in Beloochistan, where there is said to be immense deposits of oil.

MANY Southern railway companies have this year placed their old cross-ties at the disposal of the mayors of towns along the lines of their roads to be distributed to deserving poor people for firewood.

THE city of Paris has leased 27,000 acres of the low-lying forest of St. Germain and the adjoining meadows, for the purpose of experimenting in utilizing the sewage of the capital.

A COMPANY has been incorporated in New York for the manufacture of instruments to be used in telegraphing with cars and railway trains while in motion. The connections are formed through the rails and upon which the cars run.

AN earthquake shock travels about twenty-five miles a minute through hard substances, but soft substances such as sand or gravel, or clay, retard its rate of progress, and, of course, in water it gets on much slower still.

THE streets of Alexandria, Egypt, are paved with stone blocks so neatly that horse cars run upon them without rails. The cars are open, and appear like an ordinary article except that the wheels are twice the usual size.

DAVID DUDLEY FIELD will shortly deliver an address before the American Geographical Society on the nomenclature of the cities and rivers of New York, which were derived from a most extraordinary combination of Latin, French, Irish, Greek, German and Indian words.

As early as 1734 there was a settlement where the thriving capital of Manitoba now stands, but it was known as Oninipigon. In 1800 it had come to be Winipic, and reached Winnipeg in 1883. The name is derived from the Cree words, Win—dirty, and Nepe—water.

IN point of street paving the Austrian capital is somewhat behind. There are in its ten wards nearly 1,300,000 square metres of macadamized, and but comparatively few stone-paved roads. The repairs per annum and square metre, from the much frequented streets down to the quiet side lanes, vary from 1 florin 5 kreuzer (about 47 cents U. S. currency) to 19 kreuzer (9 cents U. S. currency); while those of the granite paved streets do not exceed 18 kreuzer, and in some instances are as low as 2 kreuzer per square metre.

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Atlantic Monthly	$3.25	$4.00
Century Magazine	3.55	4.00
Harper's Magazine	3.25	4.00
Harper's Weekly	3.25	4.00
Harper's Bazaar	3.25	4.00
Harper's Young People(weekly)	1.65	2.00
Popular Science Monthly	4.25	5.00
St. Nicholas Magazine	2.55	3.00
North American Review	4.10	5.00

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THE British Channel Tunnel project is again revived. At a late meeting of the Submarine Continental Railway Company, the South Eastern Railway Co. and the Submarine Continental Railway Co. were authorized, either jointly or alone, to continue experimental works for a tunnel beneath the Straits of Dover.

MEMBERS of the Engineer's Club of Philadelphia are discussing a change of name for that organization. The complaint is that the present title does not indicate the real character and scope of the society; that it is not a mere social gathering, but that its real strength is, and always will be, in the line of professional discussion and publication. Among the names suggested are the Engineer's Society, or Association, of Philadelphia and the Eastern Society of Engineers.

ARTHUR RIGGS, President of the Society of Engineers, England, evidently fears American competition in the manufacture of machinery and its products. At the late annual dinner of that Society, he referred to his recent visit to the United States, and, among other things, he was especially struck with the frequent meeting of the many engineering societies at widely separated points in this country. He spoke of the superior class of machinery used in all our manufacturies and the general intelligence of the American working class, as being in striking contrast to the second-rate tools and the cheap labor and low mental calibre of English workmen. He denounced the British trades unions as being responsible for much that denied individual freedom to the workman and kept him tied down to antiquated methods; he said that the majority of the American workmen were filled by an honorable ambition to excell in anything they undertook, and accounted in this way for the originality, neatness and cheapness of American mechanical contrivances now on the English market, and which beat Birmingham and Sheffield makers in their own homes.

An Engineering Library for all Engineering Societies.

At the Annual Meeting of the American Society of Civil Engineers a subject was broached that is deserving of further attention and a vigorous push forward towards realization. That is the suggested united action of the prominent engineering societies in this country in the founding and extension of a thorough engineering library of reference and record.

No such thing now exists in America, and it is with something akin to shame that we confess it. The American Society of Civil Engineers has undoubtedly the largest accessible collection of works relating to the profession. But what are its 15,000 titles to the mass of data that has been, perhaps, forever lost, for the want of a proper place to store it? Individually, the profession of engineering is not conducive to the accumulation of books; there is too much moving about from place to place and the active professional keeps his library within narrow fighting, or rather "flitting" limits. But every engineer *does* accumulate books, whether he will or no, as long as he is stationary, and he would willingly send them to a proper central store-house, if one existed, rather than consign them to the junkman when he does move, as is the rule at present.

Although the bulk of the accumulation referred to would probably be in the shape of transient reports, on any and every subject kindred to the profession, these very reports are well worth careful preservation. The seemingly least important document may, at some future time, furnish the missing link in a strong chain of evidence. And very frequently these paper covered and little regarded publications furnish the only record of important work. They should, therefore, be properly indexed and put away for future use, but their constantly increasing bulk and variety make it impossible for an individual to do so.

For this, among other things, we want a library, central in position, ample in shelf room, safe from fire, and so managed that all its contents shall be available, and every item of fact in it accessible when wanted. We fully realize the difficulties of the problem involved and the fact that to carry out such a scheme, as it should be carried out, requires more capital than any one engineering society can yet afford to expend. But let them unite on this library project. An engineering library is not for the civil, the mechanical or the mining engineer alone; it is equally useful to all and any of them. Each profession in turn has at some time occasion to consult the same books, and as such works are costly, why duplicate them? It is the fable of the bundle of fagots over again; any individual action is now, perforce, weak, but by a united effort very much good can be done, good in which all can have an equal share.

We do not advocate a union of the Societies, for the varying requirements for membership and existing regulations make this practically impossible, even if it were desireable. But the Civil, Mining and Mechanical Engineers of America, for example, each have a Society head-quarters in New York. Combined, the membership, would be great and have abundant means. If these societies could come together and erect a building, adapted to their common needs, and doing credit to the professions they represent, the library question would be solved for all of them. Let each society have its own individual quarters, distinct from the other; have separate meeting rooms or meet in the same hall on different dates, as they may elect. But let the library be common to all, with equal rights and privileges accorded to each Society represented. If such action were taken, the control could be vested in a Library Committee in which each body would be represented; and, that all might be equal at the start, let the organization that is poor in books make up the deficiency by furnishing a corresponding sum to purchase other books.

But they must not stop with the formation of a library; its affairs must be properly and intelligently administered. A house full of books would be worse than no library at all, unless there was a head to the concern that could at any and all times point out its treasures, great and small. A professional librarian, an organized staff and, above all, a methodical and exhaustive scheme of indexing by subjects would be absolutely required to insure success. This librarian should be simply the custodian of the books, and belong to none of the societies interested; but he should thoroughly understand his business.

This subject-index should be printed and circulated, and kept up to date by monthly library bulletins, so that the entire membership would be posted as to the contents and additions to the library. If this last project should be deemed too costly, the library index should be, in any event, kept *perfect*, so that a complete list of available data, on any subject, could be furnished on demand. A system of correspondence might even be organized, by which, for a reasonable fee, an engineer in distant parts could obtain a transcript of matter relating to any subject of special research. We are aware that this is carrying a library of reference rather far afield, but we believe that an investigator would willingly pay the cost of such clerical labor, if he only knew that the matter he wanted *was there*.

No engineer, to whatever guild he may belong, can deny the vast benefits to be derived from a complete and properly indexed technical library; and probably every engineer has at some time in his busy life keenly felt the want of such a storehouse of knowledge. The want is common in all the diverging branches of the profession, and to fill it, under existing circumstances, united action is alone wanted. It is a subject requiring deep and intelligent study, but the end would justify almost any proper means.

Land Surveying, A. D. 1562.

We have lately picked up from the shelves of a Nassau Street old-book stand a little but ancient work on Surveying, and the extracts below are simply given as professional curios. The title is odd enough to copy in full and we give it as follows: "The Moste Profitable and Commendable Science, of Surveying Landes, Tenementes, and Hereditamentes: Drawen and Collected by the Industrie of Valentine Leigh. Whereunto is also annexed by the same Author, a right necessarie Treatise, of the measuryng of all kyndes of Lande, be it Meadow, Pasture, Errable, Wood, Hill, or Dale, and that aswell by certaine easie and compendious Rules, as also by an exact and beneficiall Table, purposely drawen and devised for that behalfe. Imprinted at London for Andrew Maunsell. Anno Domini, 1577."

The author, in his preface, tells the "gentle reader" that he is one of the first that has attempted the collecting of this "Arte" into a volume, and further reminds him that, in criticising this work, he should remember that it

is "muche easier to amende, than to invente." The preface concludes as follows: "And so I ende biddyng thee, gentle Reader, moste hartely well to fare. This xxvii of October, Anno Christi. 1562."

The body of the work, which, by the by, is in most crabbed Old English characters, is devoted to the "Rentes," etc., of the "mannour," and beyond its odd phraseology and curious regulations has little of general interest. In one case it is mentioned that "where Bondsmen and Bondswomen belong to a Mannour, the Bondsman is called a Villaine, and the Bondswoman is called a Niesse. And in some Mannours all the Tenauntes are Villaines and Niesses, and then it is saied that lande is, a tenure in Villanage."

Mr. Leigh very sensibly advises the "Surveiour" to have with him "redy provided a Paper-booke, wherein he may roughly and spædily note as he goeth about the mannour;" he further warns this individual that if he makes these notes on loose papers, they may be lost or misplaced, and were "perchaunce, as good never written."

In detailing the practice of land surveying, the author refers to the "Rodde or line" as the only instruments required, and he prefers the line as the "spedier, most commodious, and also of most antiquitie." He says, "your line beyng foure Pearches of lengthe, and at every pearche ende a knot, would be well seared witn hoate Waxe and Rosen, to avoide stretching thereof in the wete, and shrinking in the drought."

The "Parties or Divisions of one Acre, accordyng to the Statute" are given as follows:

Thræ Barley cornes faire and rounde, taken out of the myddest of the Eare, maketh an	Inche
Twelve Inches make a	Foote
Thræ foote make a	Yarde
Five yards and a halfe maketh a Pearche, which in some countries men call a Pole or Rod.	a Pearche
Four Pearches make	a day worke.
Tenne daye workes or fourtie Pearches maketh	a Rode
Fourscore Pearches or twoo Roodes maketh	half an Acre
A hundred and lx Pearches or 4 Roodes, make	an Acre.

The B. & O. System of Railway Apprenticeship.

The Baltimore & Ohio R. R. is inaugurating a new departure in railway management by founding a school for promoting the better practical education of its employees.

General Order No. 5, under date of January 15, outlines the scheme proposed. Under the regulations there set forth, all apprentices of the company will be hereafter graded into three classes: 1st, apprentices; 2nd, cadets; 3rd, cadet officers. The term of service in each class will be four, three and three years respectively.

The B. & O. Company undertakes the expense of the education of apprentices and cadets passing the prescribed physical and educational requirements, and will expect to be benefited by the services of such parties, under a fair salary, for at least three years after graduation.

The pay of these apprentices and cadets is fixed as follows:

FIRST CLASS.	SECOND CLASS.	THIRD CLASS.
Year	Year	Year
1st, $ .70 per day.	1st $1.00 per day.	1st $1.50 per day.
2nd .80 per day.	2nd 1.12½ "	2nd 1.75 per day.
3rd .90 per day.	3rd 1.25 per day.	3rd 2.00 per day.
4th 1.00 per day.		

commencing with the date of admission into the service. All students will wear a uniform, the first suit free, all after that furnished at cost prices. Apprentices, possessing the proper qualifications, and all cadets are entitled to enter the technological school at Mt. Clare, Baltimore. Students whose parents have been five consecutive years in the company's employ are entitled to free tuition, text-books and apparatus. Other students, sons of employees of less than five years in service, are entitled to free tuition in the first-class, and to tuition in the second and third classes at one-half the rates fixed for other students by the regulations of the school named. Apprentices and cadets appointed outside of the service must pay full tuition rates while under the company pay.

On the completion of their course, and after passing their final examination by a board named by the company, they will be awarded diplomas entitling them to preference over non-graduates in all appointments to positions of responsibility in the gift of the railroad company.

The apprentices and cadets are not bound by indenture. Candidates for the first class must be between 15 and 21 years of age; for the second, between 17 and 22; they must be physically sound; must be well versed in reading, writing, including orthography, in arithmetic, and have a knowledge of the elements of English grammer, geography and the history of the United States.

The examining board will meet at Mt. Clare Station, Baltimore, on the first Monday of each month, when there are candidates for examinations. In the order of seniority of examination, and as vacancies occur, candidates will be assigned to probationary duty in the particular branch of the mechanical or operating department in which, according to the rating at the examination, they are best adapted. At the expiration of six months they will be re-examined and those passing will be assigned to their respective classes as qualified. Those especially advanced or apt will, with their consent, be assigned to the Company's works at St. Clare, where, in the school referred to, they will have special opportunities for technical instruction.

Good County Roads.

Francis Lightfoot, of West Chester, Pa., makes a proposition with regard to the making and proper maintenance of country roads that has merit. The fact that many of these roads, upon which a community must still largely depend for its inter-traffic, are in the same condition practically as before the advent of railroads and our modern advance, is not at all to our credit.

The plan proposed by Mr. Lightfoot may be outlined as follows: He takes West Chester County, Pennsylvania, as an example, with dimensions 31 by 20 miles, or 620 square miles, and with 1,000 to 1,200 miles of public roads. He would put this area into a systematic working shape by dividing it, north and south and east and west, by lines 5½ miles apart, and assign each district so formed to a competent and experienced roadmaster. The sub-districts could be designated by ranges and numbers as in Western Government survey. At least one third of the roads, or the leading thoroughfares, should be permanently improved, in grading and metaling, under the direction of an experienced engineer who is to have general charge of the county roads. This engineer is to select the roadmasters in charge of districts, subject to the approval of the Board of County Road Commissioners.

The money required to make these improvements could be raised by a county tax, or the issue of 4 per cent. 20 year bonds.

The chief, and a great advantage we see in the proposition as given above, is the systematic work implied, and the doing of this work under intelligent engineering supervision, according to properly prepared plans. Under existing regulations the "road-repairer" is generally his own engineer; and the work done this season must be repeated in the next, because, very generally, it had better not have been done at all. Any one who has had occasion to float through the mud-holes, or to bump over the ruts, or the boulders called "road-metal," too often encountered on the average country road, will agree that some reform is urgently demanded. And the first thing needed in this direction is a proper system and some one capable of carrying it out. The advantage of good roads to the farmers themselves, and the increase in the valuation of their lands, by being situated in an easily accessible district, is no slight consideration in favor of the adoption of this new departure in the better construction and care of county roads.

Proposed Low-level Bridge across the Thames.

The last London *Engineering* contains a plan and a short description of a proposed low-level bridge across the Thames at the Tower. The engineers are the Messrs. Kinipple and Morris; their plan includes three spans, the central span being 250 feet long and designed to swing in two halves.

The novel feature is in the two river piers, each of which encloses a shaft communicating with a tunnel under the bed of the river and connecting these two piers. In each shaft is a hydraulic lift, by which vehicles and passengers are lowered to the tunnel level and, after passing to the other pier, are lifted up again. These lifts and the tunnel to be used only in keeping up the traffic across the river during the time the draw span is open.

The draw-span as mentioned above, is in two leaves, each pivoted on the top of the river-pier and having a counter balancing shore-arm swinging clear of the top chords of the fixed spans. When the bridge is closed the clear head-way above high-water is 29 feet. As illustrated, the fixed spans are ordinary trusses with parallel chords; the swinging spans are on the suspension principle, with a tower over each pier, and the roadway truss, for one half the central span, is suspended from the lower chord of the swinging truss. The total cost is estimated at $2,500,000.

The Institution of Civil Engineers.

On January 13th, Sir Frederick Bramwell, the newly-elected President of the Institution of Civil Engineers, delivered his inaugural address before a crowded audience. He took as his subject the progress of invention since 1862 in matters relating to civil engineering: the fact that he is, by virtue of his office, the Chairman of the Executive Council of the Exhibition of inventions to be held this year at South Kensington, rendering his choice of the ground-work of his discourse peculiarly appropriate. Sir Frederick commenced by recalling the fact that the year of his birth coincided with the foundation of the Institution, and then he proceeded to pass in rapid survey the chief engineering inventions of the last two-and-twenty years. Commencing with bridge-building, he noticed the Forth, the St. Louis, and the East River Bridges, calling attention to their principal features. Next he turned to harbors, and the method of laying 350-ton blocks at Dublin. Subaqueous works followed, the Fleuss diving dress being mentioned as a noticeable improvement. In tunnelling, Beaumont and English's machine was quoted in connection with the railway under the Mersey, and the Channel Tunnel. In coal mines, the influence of the workmen was said to have hindered the production of machinery and the employment of lime cartridges. The continued existence of canal companies, in fact of railway competition, was attributed to their having widened the sphere of their operations, and undertaken the collection and delivery of goods. The Monklands incline, and the hydraulic lifts at Anderton and Fontinette, were cited as special examples of canal engineering. In the allied subject of navigable rivers, the movable Throstle Nest weir at Manchester was pointed out as a conspicuous improvement. Captain Eads' ship railway and his Mississippi

works supplied instances of schemes of transport from across the Atlantic. In military matters the Maxim machine gun, the Thornycroft torpedo boats, and the American torpedo dart were alluded to. Turning to materials there was little to say about cement, stone, and timber. The mention of steel naturally brought up the names of Thomas and Gilchrist. The improvements in iron were credited to stoves of the Cowper class, and to the increased size of the furnaces. From materials to tools was an easy step, and the speaker prophesied that fluid compressed steel would soon become universal, and that it would be worked by pressure instead of concussion. Sir Fredericks' preference for the gas engine over the steam engine is too well known to need recapitulation.

The recent balloon experiments in France were noticed, and the opinion expressed that if the French were campaigning in the Soudan they would, before this, have sighted Khartoum from a "dirigible" balloon. The distribution of gas and water, and the use for fuel of oil, producer gas and natural gas, were next touched upon, and the address concluded by an allusion to agricultural machinery.

PERSONAL.

MR. C. KIRCHHOF, JR., has resigned the editorship of the *Engineering & Mining Journal* to accept a similar post in connection with *The Iron Age*, 83 Reade Street.

HENRY K. NICHOLS has been appointed Chief Engineer of the Phila. & Reading Railroad Co., in the place of the late William Lorenz. William H. Bines, late Chief Assistant to Mr. Lorenz, has been relieved from duty.

HON. ALFRED DEAKIN, a member of the Victoria, Australia, Parliament, and also solicitor-general commissioner of public works for the Colony of Victoria, is now in California studying the American method of irrigation and of mining. He is accompanied by Mr. John Lamont Dorr, one of the editors of the Melbourne *Leader*, who is writing his American impressions for that journal.

CHARLES PAINE, formerly General Superintendent of the Lake Shore Road, and later, General Manager of the West Shore, is said to have been appointed General Manager of the N. Y. Penna. & Ohio R. R. Co. The resignation of Mr. J. M. Ferris, general superintendent of the last named road, has been tendered and accepted. MR. PAINE will at once assume full control.

GENERAL T. E. SICKELS died on Feb. 3, at his residence in Philadelphia in the 63rd year of his age. General Sickels was engineer of the Omaha Bridge, the first point of application o the pneumatic process to bridge foundations west of the Allegheny Mts. He was later engineer and General Supt. of the Union Pacific R. R. and for some time previous to his death was consulting engineer to the South Penna. R. R. His death was said to be due to inhaling the gases of dynamite in one of the tunnels on the latter road, during an inspection tour about two months ago. Gen. Sickels has held many other positions of trust and responsibility on important railroad lines, of which, however, we have no definite information.

S. S. MERRILL, General Manager of the Chicago, Milwaukee & St. Paul R. R. is reported as dying from paralysis.

SHERBURN S. MERRILL was born in Alexandria, Grafton County, N. H., Feb. 28, 1818. He lived on a farm and received such education as the public schools afforded him until he was 16 years old, when he began life for himself. One year as a servant about a hotel, six years in the employ of a Boston furnishing house, and then, in 1850, MR. MERRILL was found first in Milwaukee, engaging as boss of a crew grading a section of what is now the Prairie du Chien division of the great St. Paul system: next a train conductor, then pay-master, then Assistant Superintedent of the Milwaukee and Watertown line, then of the La Crosse and Milwaukee, then of the old Winona and St. Peter, until, in 1865, he was chosen for the duties of his present position as General Manager of the Milwaukee and St. Paul, which position he has held through all the progress in the growth of that company. His estate is worth from $1,000,000 to $2,000,000.

On Jan. 20, a committee of the New Croton Aqueduct Commission recommended the following persons to positions on the work:—

As Assistant Engineers, at $1,800 per annum: James P. Carson. Alfred A. Horne, Royal Chapin, Thomas D. Whistler, promoted from Transitman.

As Transitmen, at $1,500 per annum: Charles K. Gracie, William A. Brackenridge, John M. Stewart, promoted from Leveller, William S. Humbert, Preston K. Yates.

As Leveller, at $1,200 per annum: George H. Cunningham, promoted from Rodman,; Henry I. Dodge, promoted from Laborer; Frank N. Speyer, promoted from Rodman; David B. Lewis; Harry R. Wheeler, promoted from Chainman; Judd A. Lockwood, promoted from Laborer; Alfred Renshaw, promoted from Laborer.

As Rodman, at $75 per month: Arthur B. Satterlee, promoted from Chainman; Robert E. Nicholas, promoted from Laborer; Beverly R. Value, Josiah H. Fitch, promoted from Laborer; Isaac Baxter, promoted from Chainman.

As Chainmen, or Flagmen, at $60 per month; Andrew J. Lamb, Robert A. McKim, Langdon C. Easton, George C. Marain, Henry N. Hamilton, Joseph T. Underhill, promoted from Laborer.

The above appointments were made.

Engineers' Club of Philadelphia.

Record of Special Business Meeting, January 24th, 1885.—President J. J. de Kinder in the chair; 31 members present.

The following gentlemen were elected Active Members of the Club: Messrs. Chas. M. Jarvis, Saml. J. Creswell, Joseph S. Ward, H. W. Dunne, Wm. M. Levering, Chas. P. McArthur, John B. Fontaine, Geo. G. Hood, John D. Newbold, T. A. Reilly, P. W. Taft and C. H. Middleton, Jr.

Mr. John C. Trautwine, Jr., exhibited and described drawings of a large Land Dredge built by the Osgood Dredge Co., of Albany, N. Y., for the Pacific Guano Co., to be used in removing 8 to 15 feet of material from the phosphate rock at Bull River, S. C.

Mr. Chas. T. Thompson presented a Description of the Construction and Manner of Turning of the Large Hoisting Drums of the Calumet and Hecla Mining Company.

Mr. Thompson also read an interesting letter from Mr. Henry A. Vezin, alluding to the Iron Mining Methods in Colorado.

The Secretary was enabled to present, through the courtesy of Samuel C. Perkins, Esquire, who had loaned it for the purpose, a description of the so-called Artesian Wells of New York City, embodied in a written report thereupon by Dr. Cyrus Edson, Chief Inspector of the Health Department. Of nine wells examined by Dr. Waller (the waters of eight of which were used, without treatment, in the manufacture of soda and mineral waters) all but one, which was pronounced "doubtful," are characterized as "bad and extremely dangerous for drinking purposes." All but one of the wells are under 70 feet deep. The explanation of this pollution is given as follows:

"The strata composing the island, originally deposited in a horizontal position, have been thrown into folds, probably by the geological changes effected by the eruption of the material now forming the Palisades (the trap—a solidified form of lava.) After that the valley of the Hudson became the bed of an immense glacier, which ground off the top of the ridges, at the same time filling up the hollows with the boulders, sand and other detritus which it carried with it. The result is that our island consists of the upturned edges of the strata so worn off, and any water falling on the surface soaks in, guided by the trend of the strata, to make its appearance in a well (whenever such may be sunk) on the island. In other words, the water in any of the wells, however deep, is the drainage from the district closely adjacent to the spot where the well is sunk."

Michigan Engineering Society.

The Sixth Annual Meeting of this Society will be held on the 17th 18th and 19th inst., in the State Capitol, Lansing, Mich. The officers of 1885 are: President, Prof. J. B. Davis, of Ann Arbor; Secretary and Treasurer Prof. R. C. Carpenter, of Lansing. The following is the programme for the coming meeting:

FEBRUARY 17TH.

Report and Suggestions of President.
Report of Executive Committee.
Report of Committee on Manual.
Report of Standing Committees.
Report of Secretary and Treasurer.
Paper—Restoration of Lost Corners. By M. S. Cook, C. E., Manistee.
Address of the President: The Engineer; What Sort of a Man is He?

FEBRUARY 18TH.

Paper—Estimating the Amount and Value of Standing Pine Timber. S. S. Hastings of St. Louis.
Paper—Practical Queries Answered, by I. H. Leavenworth, Saginaw City.
Address by M. E. Cooley, Professor of Mechanical Engineering, University of Michigan.
Paper—Construction of Iron Lighthouses. W. S. Russel, Supt. Russel Wheel and Foundry Co., Detroit.
Paper—The Separate System of Sewerage. By Geo. S. Piersons, Kalamazoo City Engineer.
A System of Water Works Designed for Ann Arbor. By Professor C. E. Greene, Ann Arbor.
Development of Water Supply. W. R. Coats. Kalamazoo.

FEBRUARY 19TH.

Paper—Suggestions to Beginners in Land Surveying. Dorr Skeels, Grand Rapids.
Cause of Compass Deviations on Vessels. H. C. PEARSOLS, Ferrysburg.
Report of Committee on Exhibition of Instruments.
Maintenance of Way. E. Treadwell, Assistant Roadmaster F. & P. M. R. R.
Location of Canadian Pacific Rocky Mountain Division. F. P. Davis, formerly Resident Engineer, Washington, D. C.
Legal Position Occupied by a Surveyor in the State of Michigan. By Hon. L. S. Montague, Howell.
Legal Requirements for Village Plats. Hon. Geo. E Steele, Traverse City.

EXHIBITION OF INSTRUMENTS.

An unusually large exhibition of instruments is expected.

The firms of Young & Sons, Philadelphia, W. & L. E. Gurley, of Troy, N. Y., and L. Beckman, of Toledo, O., have already signified their intention to be present.

Iowa Surveyors.

The following circular has been received:

OSKALOOSA, IOWA, January 21, 1885.

DEAR SIR:—An extensive correspondence with the Surveyors of Iowa shows that there is a general desire that a change be made in the Surveying Laws of our State, and also a Surveyors' Convention will be of great benefit, aside from the legal issues.

Arrangements have been made for holding a Convention at Des Moines at the County Court House, on Tuesday, February 24th, 1885, at 2 o'clock P. M., which you are earnestly asked to attend, and to invite any Surveyors and Engineers you know.

Some of the matters for consideration, which have occurred to us, are briefly as follows:

1. Organization of a Surveyors' and Engineers' Society.

2. Discussion of any questions arising from practical work.

3. Discussion of Sections 569, 3800, 3824, 3844: Chapter 8; 15 G. A., page 862 McClains Statutes, and Sections 369 to 378 inclusive.

Under No. 3 above, the following ideas occur to us:

(a.) Surveyor to choose his own help.

(b.) *All* surveys to be recorded and fees to be paid for same.

(c.) Include Surveyors in Section 3844, providing office, etc.

(d.) Surveyor to have $5.00 per day, paid by the county and collected by the Treasurer as a special tax on all the property benefited by the survey, in a similar manner as now provided in Section 568.

(e.) Section corners to be located and maintained at

the county's expense, and the manner of locating and making the same specified in the law.

(f.) Power to make irregular surveys (Sec. 567) to be vested in Surveyor instead of Auditor, and Surveyor to keep the transfer books and have the transfer fee.

(g.) Term of office, 4 years.

If it is impossible for you to attend the convention in person, please let us hear from you fully on all matters in which the spirit moves you. Address,

IRA J. STODDARD,
Oskaloosa, Iowa.

Western Societies of Engineers.

At the regular meeting held January 20, Vice-President Randolph introduced President Williams who delivered an inaugural address.

Mr. Wright, for Committee on transportation, announced a paper for the next meeting, "ventilation of stables."

It was voted that the committee on portraits have the portrait of President Williams added to the collection of President's portraits.

Mr. G. C. Bramhall read a paper "what civilization owes to the architect and engineer,"

It was voted that the address of the president and the paper by Mr. Bramhall be printed.

CORRESPONDENCE.

Special Correspondence Engineering News.

Correction.

RICHMOND, VA., Jan. 28, 1885.

EDITOR ENGINEERING NEWS:—We notice in the Intelligence columns of your issue of the 17th inst., an item stating that the "Canton Iron Bridge Co., of Canton, Ohio, has received a contract to erect six iron bridges over different streams in Gilmer county, W. Va.," which is incorrect. The six bridges in question will be erected by us, we having signed a contract for them December 1, 1884. It is possible that the Wrought Iron Bridge Co. may furnish us the iron work for them if they bid low enough.

A correction may be worth making, and will oblige

Very respectfully,
STEWART SHIRREFFS & Co.

Deep Wells.

BAY CITY, MICH., Jan. 27, 1885.

EDITOR ENGINEERING NEWS:—In your issue of January 24th, under the heading "Water," I notice a statement that "the only bore in the world deeper than the Winchester," the artesian well spoken of, "is a Pennsylvania oil well."

A salt well is now being sunk in this city which has at present reached the depth of 2,576 feet, 170 feet deeper than the Winchester, and it is proposed to carry it down some distance farther. The object is to reach the solid salt rock believed to lie below the sand rock from which brine is now pumped at the Bay City wells.

Respectfully,
W. H. MCEWAN.

Road Inspection of the Savannah, Florida & Western, and Charleston and Savannah R. R's.

We are indebted to Road Master J. W. Craig, for the following inspection rules, and the report of the first annual inspection on the last named railroad.

The recapitulation of the report gives, under the rules quoted below, for the First Division, 7.48; for the Second Division, 8.00; for the average of the whole road, 7.74.

The order regulating the annual and quarterly inspections is as follows:

SAVANNAH, GA., June 4th, 1884.
ORDER NO. 65.

I. From and after July 1st, proximo, there will be Annual and Quarterly Inspections of these Roads, the inspection of each being independent of the other.

II. The Annual Inspection will be conducted by the Superintendent, assisted by the officers of the Roadway Department, the Chief and Assistant Engineers, and such other persons as he may invite.

III. The Quarterly Inspection will be conducted by the Master of Roadway, assisted by the officers of the Roadway Department.

IV. The Quarterly Inspection shall be made on or about the end of each calender quarter, and the Annual Inspection shall be made in July of each year, and shall take the place of the second Quarterly Inspection of each year.

V. The *Annual Inspection* shall determine the condition of each Section and Division in the following particulars:

A. Line.
B. Surface.
C. Level.
D. Frogs, Switches and Guard Rails.
E. Drainage.
F. Policing or cleanliness of tracks and grounds.

These conditions shall be determined by a system of marking for every mile of road: 10 shall indicate perfection; 0 shall indicate the worst possible condition, and the intermediate numbers shall be used to represent in a proper ratio intermediate conditions.

VI. A system of rewards and classifications shall be adopted for each Annual Inspection, as follows:

A. The Division on the Savannah, Florida and Western Railway showing the highest general average of points in the various conditions noted under Paragraph V. shall be rewarded by a premium of $100 to the Supervisor; the second highest average shall be rewarded by a premium of $50 to the Supervisor.

The Division on the Charleston and Savannah Railway showing the highest general average of points in the various conditions noted under Paragraph V. shall be rewarded by a premium of $50 to the Supervisor

B. The Section on each Division showing the highest average of points shall be rewarded by a premium of $40 to the Section Foreman and the second best by $20. Section Foreman to be eligible to these premiums must have been on the same sections at least six months previous to date of inspection.

C. (a.) Sections where the general average is found to be eight and over shall be classed as first-class, and the Foremen of such Sections shall be classed as first-class Section Foremen. To be entitled to this classification a Section Foreman must have been on the same section at least six months previous to date of inspection.

(b.) Sections where the general average is found to be six and over, but less than eight, shall be classed as second-class, and the Foreman of such Section shall be classed as second-class Section Foreman.

(c.) Sections where the general average is found to be four and over, but less than six, shall be classed as third-class, and the Foremen of such Sections shall be classed as third-class Section Foremen.

VII. 1st. The *Quarterly Inspection* shall determine the same conditions, in the same manner, as indicated in Paragraph V. of this order

2nd. A system of reward and classification shall be adopted for each Quarterly Inspection, as follows:

A. The classification under C. Paragraph VI shall be determined and its provision carried out at each Quarterly Inspection.

B. The Foreman of the Section on each Division showing the most improvement shall be rewarded with a premium of $10, provided the Foreman has been on the same section for three consecutive months previous to date of inspection.

C. The Section Foreman on each Division who will have operated his Section with the least amount of labor per mile of track, will be given a premium of $15. To be entitled to this premium a Foreman must show a condition of track equal, if first-class, or improved by one point at least if second, or by two points at least if third class, to that shown by the previous inspection, and he must have served continuously in charge of the same force for at least three months previous to date of inspection.

D. The Section Foreman on each Division who will have made the most progress in bringing the Cross Section of the road-bed up tostandard shall be rewarded with a premium of $10.

E. The Foreman of the Gang on each Division who will have operated his Gang with the least expense for tools per man shall be given a premium of $10.

VII. A difference of one will be allowed in classification of Foremen between iron rail and steel rail track.

IX. These inspections will go into effect with the Annual Inspection for July, 1884, being *understood*, that no premiums will be given at the first Annual Inspection, but the condition of track will be noted for comparison at subsequent Inspections.

H. S. HAINES,
General Manager.

LITERATURE.

Transactions and Proceedings of the American Society of Civil Engineers, November, 1884.

Contents:—Analysis of the Rainfall at Lake Cochituate, Mass., by DESMOND FITZGERALD, and discussion. Description of some Experiments on the Flow of Water through 2¼ inch. Rubber Hose, and Nozzles of various Forms and Sizes, made on the Providence Water Works. Also Results of Investigations relating to the Height of Jets of Water, by EDWARD B. WESTON. Management of Forces Engaged in Railway Track Repairs, by BENJAMIN REECE.

The Firemen's Guide. A Handbook on the Care of Boilers. By TEKNOLOGFORENINGEN, T. I., Stockholm. Translated from the Third Edition and Revised by KARL P. DAHLSTROM, M. E., E. & F. N. Spon, Publishers, New York and London, 1885.

This book was originally written and published by a society of experienced engineers, with the terrible name given in the title. It is intended to lessen the number of accidents to boilers, due to neglect or incompetency of the attendants, and to save fuel, etc., by giving strict rules governing the firing and management of boilers.

The work is divided into two parts, the first relating to the general care of boilers, and the second gives a summary of regulations. It has been favorably received in Sweden, and has already passed through several editions.

Curve Tracing in Cartesian Co-ordinates, by WILLIAM WOOLSEY JOHNSON, Professor of Mathematics at the U. S. Naval Academy, John Wiley & Sons, New York, 1884. Price $1.00.

This book relates only to the definite problem of ascertaining the form of a curve given by its equation in Cartesian Coordinates, in cases likely to occur in the actual application of Analytical Geometry. The methods employed are exclusively algebraic, no knowledge of differential calculus being assumed, on the part of the reader. To confine the treatment of this subject within reasonable limits, the author has introduced the device of the Analytical Triangle and used it in connection with all methods of approximation.

The Maritime Canal of Suez, from its Inauguration, Nov. 17, 1869, to the year 1884. Prepared under orders of the Bureau of Navigation, Navy Department, by Prof. J. E. NOURSE, U. S. N., Washington, 1884.

Thirty-Second Annual Report of the Railroad Commissioners of the State of Connecticut, to which are added Statistical Tables compiled from the Annual Returns of the Railroad Companies of this State. Hartford Conn. State Printing office, 1884.

Report on the Survey of the West Virginia and Pennsylvania Boundary, 1883, by C. A. SINCLAIR, U. S. Coast and Geodetic Survey, for the Commission, Wheeling, W. Va. State Printer 1884.

The above is a record of the proceedings of the Virginia Commission, and in its general details differs little from the report of the Pennsylvania Boundary Commission, already noted in this journal.

On the Adaption of Movable Dams to the Ohio and other rivers of the United States as practical by the U. S. Corps of Engineers, by PROF. LEWIS M. HAUPT, University of Penna.

This pamphlet is a reprint from the Proceedings of the Engineers' Club of Philadelphia. The data is collated from the reports of the various engineer officers in charge to the Chief of Engineers at Washington. The subject is an important one especially when we consider that the territory effected by the improvement of the Ohio River is that tributary to 20,000 miles of inland navigation, with a commerce of greater value, than the entire foreign commerce of the United States. Prof. Haupt enters very fully into the description, detail and working of the existing dams and into the cost and benefit of the improvement.

Locomotive Engine Running and Management: a Treatise on Locomotive Engines, showing their performance in running different kinds of trains with economy and dispatch; also directions regarding the care, management and repairs of locomotives and all their connections, by ANGUS SINCLAIR. John Wiley & Sons, Publishers, New York, 1885. Price, $2.00.

The author, who has been a practical locomotive engineer and is now one of the editorial staff of the *American Machinist*, originally furnished most of the matter contained herein to the journal named; but it has been since rearranged for the present publication.

The book is intended for the use of engineers, firemen, machinists, and others interested in the locomotive, and is, consequently, clear in expression and easily understood, only the elementary problems in mechanical engineering are involved and these are treated in the simplest manner. The book is well and fully illustrated, and gives valuable "points" on all the details connected with the running of a locomotive.

Energy and Motion, a text book of Elementary Mechanics, by WILLIAM PAICE, M. A. Cassell & Co., London and New York, 1885. Price $0.75.

This is a very clear and simple introduction to statics, dynamics and kinetics. Numerical illustrations precede the general rules, the object being to lead up to the laws of force and motion, rather than to start with those laws and deduce simple notions from them. The subject of energy or work is not developed to that extent which its importance demands although it is made the basis for deducting the fundamental relations for the lever, inclined plane and pulley. The new absolute unit of force, the poundal, is introduced, and we question the advisability of using it in an elementary primer, although its theoretical advantages are undoubtedly great. It is no easy thing to obtain clear and definite ideas of mass, momentum, acceleration, energy, and other fundamental mechanical conceptions, and hence elementary text books are to be commended and encouraged.

ENGINEERING NEWS for three months One Dollar.

TRACK.*

BY W. B. PARSONS, JR., C. E.
ROADMASTER SUSQUEHANNA DIVISION ERIE R. R.

(*Continued from page 76.*)

The next question is whether in laying track the joints should be placed "opposite" or "broken." With the old fashioned chairs joints were always opposite. Ballast was poor and joints were weak, and it was preferred to ride with a series of vertical jumps rather than oscillations. Even the early forms of splice bars were but little more than hinges and scarcely remedied the defect.

With the present improved angle plates which approximate to the strength of the rail the decided tendency of good practice is toward broken joints, although some claim even now, that in poor ballast it is best to have them opposite. But the author, after an experience in all kinds of good and bad ballast, is

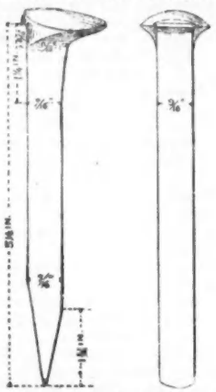

FIG. 50. RAILROAD SPIKE.

decidedly in favor of broken joints under all conditions on account of less labor of maintenance and better riding qualities. Those who will examine a piece of track laid with broken joints will notice on the rail opposite each joint a spot of increased wear, seen most clearly when light is reflected from it. This shows that the jump caused by a joint is transmitted by the track to the other rail and produces a deteriorating effect thereon.

Now suppose the joints opposite, the pounding on each rail caused by the joint would be increased by a sympathetic jar from its opposite mate.

Joints get low much quicker this way, and labor to keep them up, is decidedly increased.

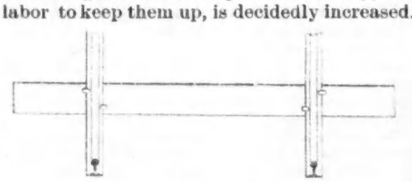

FIG. 51. ARRANGEMENT OF SPIKES.

The oscillation objected to in broken joints is more fancied than real, for when the joints are broken one side of the track is always traveling on an even bearing, while both sides strike the joints together when they are opposite.

In question of line the value of broken joints is still more apparent. Unfortunately the strength of joints is still inferior to that of the rail, and when laid opposite the weak parts of both strings come together; hence on curves the track tends to form angles at the joints, and the increase of labor to keep track with opposite joints in line on sharp curves varies from 10 per cent. to 25 per cent.

The usual dimensions of a track spike, fig. 50, is 5½ inches long and $\frac{9}{16}$ square, and it weighs about ½ lb., generally put up in kegs of 200 lbs. each. They should be straight, snug up to the rail and kept there. Every tie should be spiked, and to prevent shoving, the inside spikes should both be on one side of the tie, and the outside spikes on the other, as in fig. 51. So that which ever way the tie tries to turn it has one pair of spikes resisting. This is a simple, practical detail often neglected. To hold rails on very sharp curves where the ordinary spikes have not sufficient strength, the Bush Interlocking Bolts, fig. 52, have been

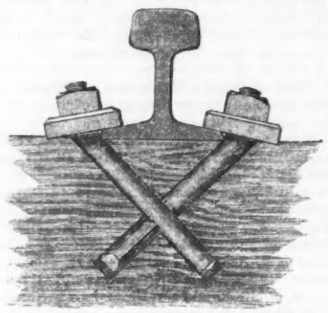

FIG. 52. BUSH INTERLOCKING BOLTS.

invented. Two bolts are driven in holes bored by means of a special guide tool and then turned to grip each other in notches; the nuts are then screwed down fast. Their expense prevents their general use, except in special cases. For very sharp curves, guard rails and in fact all rails which have to resist a strong side thrust, cast-iron "Knee Braces" are used. Fig. 53 shows a very good form, the

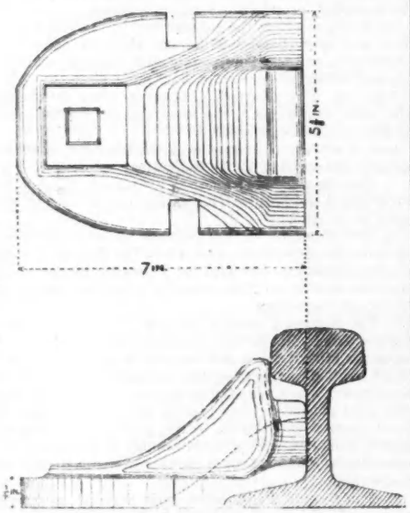

FIG. 53. KNEE-BRACE.

weight of which is about 9 lbs. Its center is cored out according to the dotted line in order to save weight and so that it can be set over the regular spike. The top of the brace gives support to the side of the rail head as well as the web, a feature not generally seen in other designs, while to allow vertical motion of the rail independently of the brace, which occurs when the rail sinks into the tie under a load, the under part does not come up to the under side of the head by half an inch. These braces should be used on all curves over 8°, on lead rails of turnouts where running is fast, rails, bolted and keyed frogs, etc. For 8° curves, two braces are sufficient, which number should be increased with the degree of curvature and amount of traffic.

The material required for one mile of single track railroad—which when laid with 30 feet rails has 176 joints—is given as follows:

$94\frac{640}{2240}$ tons (60 lb) rail.
2816 cross ties (16 to a 30 feet rail).
704 splice bars.
1408 bolts (9 kegs, 150 lb. each).
11264 spikes (30 kegs, 200 lb. each).

(TO BE CONTINUED.)

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IT is said Cape Cod Canal will cost $7,500,000 and consume three years in digging.

The Gulf Stream.

The *Shipping Gazette* (*vide* January 13) sounds an alarm about the proposed Panama and Nicaragua canals, dreading they "may materially affect the climate of the western world by interfering with the Gulf Stream." It informs its readers, for the most part commercial and nautical people who are deeply interested in these important undertakings, that "it is from the broad and deep reservoir of the Gulf of Mexico that the famous stream issues by the Strait of Florida to flow in a north-easterly direction towards the coasts of Europe." Much of this is erroneous, for the latest surveys of the United States cruisers, specially commissioned for this work, have proved that little or none of the water of the Gulf of Mexico goes to form the Gulf Stream. That wonderful current draws its supplies almost entirely from the tropical waters of the North Atlantic. The north-westerly Guiana current and the westerly drift of the tropical waters enter the Carribean Sea, and are diverted directly towards the Strait of Florida by the peninsula of Yucatan. Panama and Nicaragua are far beyond the limits of these currents, and the Gulf of Mexico might become a prairie, westward of the 90th meridian, without affecting the Gulf Stream. After stating its stupendous magnitude as "At the narrowest part in the strait the stream is thirty statute miles in breadth, and 1950 feet in depth, but as it travels north it widens until it covers an enormous area," the writer conceives that "if a canal be successfully cut, the waters of the Gulf Stream, which now flow out through the Strait of Florida, might pass into the Pacific;" and that "if two canals were cut there is at least the possibility that they may exercise a marked influence for evil upon our climate." The monstrosity of the former conception appears stupid in relation to the spectrality of the latter. The article altogether is a "prodigy of jargon and absurdity." Panama is 800 miles south of the Gulf Stream, Nicaragua not much nearer; and neither site can be said to be within the influence of the westerly current. It would be as reasonable to expect a camel to go through the eye of a needle, as to expect any appreciable portion of these waters to pass through the narrow channels of these canals. Both the facts and the fancies are fallacious.

Engineering.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E. ; M. INST. C. E.

Continued from page 77.

DCCXIII. FREMONT, OHIO.

Fremont, Sandusky Co. Ohio, in lat. 41° 20' N., long. 83° 5' W. is on the Sandusky River at the head of navigation and was formerly called Lower Sandusky.

Water-works were built by the City in 1883 after plans and under the direction of J. D. Cook, C. E., the supply being taken mainly from springs, the water from which is stored in a reservoir, situated within the limits of the city near the Sandusky River and having a capacity of 2,500,000 gallons. Thence it is pumped by one compound condensing, and one non-condensing Knowles Steam Pump having a combined daily capacity of 3,800,000 gallons to a tank 100 feet high and 25 feet in diameter constructed of Otis Steel, built on a hill one half a mile distant from the pumps and 50 feet above the level of the central part of the city.

Distribution is by 10 miles of cast-iron pipe with 96 fire-hydrants, 5 meters and 200 taps. Service pipes are of lead and galvanized iron. The daily consumption is 275,000 gallons. The population in 1880 was 8,446. The works have cost $140,000. The bonded debt is $135,000 at 5 per cent. The yearly expenses of maintenance are $3,000, and the receipts $5,000. The works are managed by a Board of Trustees

of which Charles F. Reiff is President and Joseph Schwartz, Secretary.

DCCXVIII. FRESNO, CAL.

Fresno, Fresno Co., California, is in lat. 36° 30' N., long. 119° 30' W.

Water-works were built in 1876 by a private company taking the supply from ground water. Two wells of 8 and 10 inches diameter respectively are bored to a depth of 100 feet, and from them the water is pumped by a Holly Steam Pump directly into the mains.

Distribution is by 3 miles of cast-iron pipe of 4 inches diameter with one fire-hydrant, 2 meters and 300 taps.

The town does not pay for fire service. The cost of the works has been $30,000. There is no debt. The expenses of maintenance are $400 and the receipts $700 per annum. The daily consumption is 200,000 gallons.

The population in 1880 was 1,112.

Thomas Whitlock is Secretary of the Company.

DCCXIX. GEORGETOWN, TEXAS.

Georgetown, Texas in lat. 30° 50' N., long. 97° 45' W. the county seat of Williamson Co., is on the San Gabriel River.

Water-works were built in 1884, by a private company in which the city has a controlling interest, after plans of G. C. Heron and under the direction of M. P. Kelley, taking the supply from a spring, the water from which is collected in a well 18 feet long, 12 feet wide and 24 feet deep. The water is thence pumped by a Worthington pump of 16½ inch steam and 10½ inch water cylinders and 12 inch stroke, lifting 200 feet to an iron tank 20 feet in diameter and 100 feet high.

Distribution is by 5 miles of wrought-iron pipe of 10 to 4 inch diameter with 20 fire hydrants, and 20 gates. Service pipes are of wrought-iron. The works having just been completed the number of taps is not stated. The works cost $51,000, the city issuing bonds for $36,000 at 6 per cent., and the remaining $15,000 being furnished by the company. The contract between the city and company is for 25 years, the former receiving fire protection and the latter managing the works and collecting all water rents during that period.

The population in 1880, was, 1,354 and is now said to be 3,500. C. E. Taylor is Secretary of the company and M. P. Kelley, Superintendent.

DCCXX. GIRARD, KANSAS.

Girard, Crawford Co., Kansas in lat. 37° 30' N., long. 94° 45' W. was settled in 1869, and incorporated a city in 1883.

Water-works were built by the city in 1882 after plans of Wm. H. Burnham, taking the supply from an artesian well 5 inches in diameter and 800 feet deep.

A deep well pump of ¾ inch bore and 24 inch stroke operated by a wind-mill 25 feet in diameter, made by the U. S. Wind Engine & Pump Co., lifts the water from a point 240 feet below the surface to a wooden tank 18 feet high and 24 feet in diameter set on a timber trestle 30 feet high. There is also a steam engine used as an auxiliary.

Distribution is by ½ mile of 6 inch cast-iron pipe with 4 fire hydrants and 35 taps. There are no meters in use. Service pipes are of wrought-iron. The daily consumption in 1883 was 8,000 gallons. The population in 1880 was 1,289 and is now said to be 2,100.

The works have cost $10,000. The bonded debt is $8,000 at 7 per cent. The yearly expenses of maintenance are $150, and the receipts $600.

John Tontz is Mayor of the city, and A. C. Swartz Chairman of the Water-works Committee.

CORRECTION.—In the issue of Jan. 10th page 29 the distribution pipes of Brainerd, Minn. are stated to be of cast-iron. This is an error, as Kalameined wrought-iron pipe of the following lengths and sizes, tested to 250 lbs. per square inch were furnished for those works by the National Tube Works.

26120 feet of	4 inches.
14540 feet of	6 "
1460 feet of	8 "
4700 feet of	10 "
1390 feet of	12 "

The service pipes are also of Kalameined wrought-iron.

WATER.

THE Jamestown, Dak., Water Works Co. have failed.

AN estimate of the cost of the proposed drainage system of Kingston, Canada, has been placed at $44,000.

BILLINGS, MONTANA, is endeavoring to get permission to build water-works.

SOME of the citizens of Martin's Ferry Ohio, are protesting against the bill authorizing that town to borrow money for water works.

THE Maine Legislature has passed an act incorporating the Bath, Me., water works, and the Gardiner water works to supply the village of Norway, Me.

THE Phillips, Me., Water Co., now erecting works, is about to apply for a charter to furnish Farmington, Me., with water.

THE total yield of the Sudbury river during January was 2,878,400,000 gallons, or a daily average yield of 92,852,000 gallons.

SOUTH FRAMINGHAM, Mass., voted on Feb. 1, to contract with the Framingham Water Co., to supply water to 60 hydrants for 3 years.

MILTON J. SHAW, of Greenville, Me., petitions the Maine Legislature to incorporate the Chain of Ponds Improvement Co.

LANSING, Mich., Jan. 26.—The proposition to bond the city for $100,000 for the construction of water-works was carried to-day by a very large majority.

THE initiatory steps have been taken in the Macon, Ga., Council to secure a better drainage system for that city.

THE Lewiston, Me. *Journal* notices the incorporation of the Philips water-works, in Maine. Incorporators M. Jordan, Edwin T. Gile and N. J. Jordan. Capital stock, $1,000,000.

THE Atlantic, Ga., artesian well is now 1200 feet deep. Col. Baum, the contractor, says the water comes to within 125 feet of the top now, and expects to soon reach a quantity sufficient.

THE city water-works Co., of Belleville, Ill., has just been incorporated. The incorporators are Henry C. Comegys, Samuel H. Lockett, and H. G. Weber. Col. Lockett is the Chief Engineer of the works.

THE Committee on Water Supply of the Mass. Legislature is giving a hearing to parties interested in the petition of Francis A. Rugg and others for the incorporation of the Docks Pond Reservoir Co.

THE committee on water supply for the Philadelphia Public Buildings, recommend the laying of a 12 inch main from Belmont Basin for the exclusive use of the city building, and also to have a connection with Fairmount Basin. The building will have its own pumps for use in any emergency.

THE Atlanta, Ga., *Constitution* reports the water works of that town in a bad fix; only one engine and that liable to get out of order and a pressure of only 20 lbs. to the square inch. Superintendent Richards says the trouble lies in trying to force 5,000,000 gallons of water daily through a 2,000,000 gallon main.

TORONTO, Can., is wrestling with the problem of water-waste. With a population of 100,000 the daily supply is now 12 millions of gallons, or 120 gallons per head per diem. It cost $50,000 last year to pump the water into the reservoir, and with the present consumption the two engines are just capable of meeting the demand. Another engine is being built to supply the margin of safety required.

THE Bay State Sugar Refinery, of Boston, lately burned, says that the question of rebuilding is still unsettled. The excessive cost of water and coal in Boston, as compared to Brooklyn, Jersey City or Philadelphia, is given as the cause of the delay. They say it will cost them $30,000 per year more in Boston than in the cities named. The water item alone is $6,000 in excess of the other towns.

SAN FRANCISCO has expended upon her water supply not over $1,000,000, but is now about to undertake an extension at an expense of $1,340,000. In 1870 the number of water consumers in the city was 12,640, and the consumption during the entire year was 2,204,165,000 gallons, and the collections $816,859.10 while in 1884 there were 20,610 consumers, using 5,567,534,000 gallons, and the collections were $1,273,472.41. The total number of street main pipes is 1,034,899 feet, or 196 miles; and of county main pipes 32 miles. The water supply is obtained in San Mateo County.

LANSING, MICH. WATER-WORKS.—On the 26th of Jan. the citizens of Lansing voted to bond the City in $100,000 to build water-works. It was carried by a vote of 445 for and 49 against. Jas. Appleyard, contractor, had a great deal of the credit for bringing about such a result It is the purpose to construct as complete a works as can be found in the country: 16, 12, 10, 8 and 6" mains will be used, no 4" except where there will be no extensions, will pump from a well supplied by water taken from the sand rock 100 feet below. The pumps will be Compound Duplex, two in number, of 1½ millions each. Direct pressure system will be adapted at present, and in a few years a stand pipe will be added.

THE Government is about to construct a ditch eight miles long to water the severalty lands of the Crow Indians on the Little Big Horn in Montana.

THE Norway, Me., Water-works, is incorporated with a capital stock of $40,000 and not to exceed $60,000. It is authorized to take water from Pennesseewassee Pond or streams tributary to it.

EAU CLAIRE, WIS., is negotiating for water-works. At least 15 miles of main will be wanted at once and 200 hydrants. Water will be taken from Dells Pond 1½ miles from the city.

ARTHUR G. MOORE, late Superintendent of the Cincinnati water-works, has renewed his proposition of November last to guarantee the completion of the partially constructed engines in the pumping station for $98,000.

THE following Maine towns are now petitioning the State Legislature for water-works:—Norway, $40,000; Rockland, $80,000; Houlton, $30,000; Waterville, $100,000; Phillips, $100,000.

THE construction of the eastern intercepting sewer in Lynn, Mass., at a cost of $110,000, as provided for in the drainage plans of Rudolph Hering, C. E., is postponed for the present.

THE Geo. F. Blake Manufacturing Co., of Boston and New York, have filed a lien of $15,900 against the Council Bluffs Water Co. for balance due and unpaid on pumping machinery.

THE Prohibtionists statement that two or three millions of dollars are annually spent for liquor sinks into significance when we think of Captain Eads asking the Government to spend $8,760,000 for eighteen feet of water in Galveston Harbor.

Still, water always was scarce in Texas.—*Exchange.*

ON January 28, the Toronto, Can., Councils took into consideration the advertising for, and appointment of, a general manager for the city water-works. The idea is to relieve the city engineer from the many duties connected with the Water Department. The motion was adopted.

THE St. Louis Board of Improvements on Jan. 26th received the following proposals for laying about eleven miles of water pipe: Fruin-Bambrick Construction Company, $63,623; D. Clifford & Co., $59,490; G. Eyerman, $61,290; John O'Donnell & Bro., $59,461; August Heman, $65,190, and Joseph Weber & Co., $65,307. The amount of castings to be used will aggregate 7,500 tons, costing about $350,000.

THE Maine Legislature will be asked to pass an act to incorporate the Augusta and Hallowell Water Company. The incorporators are J. Manchester Haynes, E. C. Allen, H. M. Heath, H. S. Osgood, P. O Vickery, Ira H. Randall, Geo. E. Weeks and J. R. Bodwell—a corporation by the name of the Augusta and Hallowell Water Co., for the purpose of conveying to and supplying the cities of Augusta and Hallowell with pure water. Capital, $40,000.

THE Williamsport, Pa., Water Co., organized in 1856, has consolidated with the citizens Gas and Water Co., organized in 1864. These companies have been fighting for some years past as to the legal right to supply certain territory lying between the limits defined in their charters. The business of the two companies will be carried on, after Feb. 1, by the superintendent J. H. McMinn.

W. A. SIMMONS, Chairman of the Boston Water Board, sends a communication to the aldermen advocating the proposed reduction in water rates to manufacturers, from two cents per 100 gallons to one cent per 100 gallons. The Water Board recommended the reduction, but the Aldermen rendered their action void. Mr. Simmons says that Boston is behind every city of importance in cheapness of water supply to manufacturers.

NORTHFIELD, STATEN ISLAND.—Capitalists have organized a company to build a large artificial lake in the town which will cover 1,600 acres and hold 10,000,000 gallons. It will receive a watershed from ten miles of woodland. Hundreds of creeks and springs will empty into it. The projectors propose to supply drinking water to villages and cities in New Jersey through large iron aqueducts that will be laid across Staten Island Sound, which at one point is narrow. The dam will be 4,400 feet long and twelve feet high.

THE earnings of the Concord, N. H., water-works for 1884 were $28,915.65, of which $28,702.20 was from water rates, and the total expenses, $5,243.34, making the net income $23,672.31. The interest on $350,000 at 6 per cent. and on $43,000 at 4 per cent. was paid, leaving a net balance of $1,052.72. The total receipts for 12 years have been $259,665.61.

There were added during the year, 2,745 feet of distribution pipe, 1,619 feet of service pipe, 6 gates, and 2 fire hydrants, making the totals as follows: Distribution pipe, 162,077 feet; 1,877 service pipes, 41,937 feet; gates, 197; hydrants, 104.

Water is now supplied for 2,213 families, 210 bath tubs, 617 yard hydrants, 89 heating apparatus, 9 fountains, 550 horses, 149 cattle, 82 offices, 106 stores, 25 stationary engines, 10 water motors, 3 drinking fountains, etc.

A GENTLEMAN has shown the Savannah *Times* reporter a section of water pipe which had been gnawed through by rats. The pipe is of lead. The cause leading to the discovery of this fact was that water commenced to leak through the house, and he ordered a plumber to come and find the leak. A thorough search was made and this pipe was found with a hole gnawed through it large enough to allow the insertion of a man's thumb. The imprint of the rodent's teeth could be plainly seen. The plumber, who made the discovery, said it was the first case of the kind he had ever known. As it was a waste pipe through which the kitchen refuse passed, and as it was greasy, it is presumed that this fact caused the attack of the rats.

ON January 13, a committee of the citizens of Oswego, N. Y., reported on the question of a new or cheaper water supply for that city. The committee claim that the rental of $25,000 per annum, now paid by the city to the Oswego Water Co., is too high, and it shows by comparison with other cities that instead of paying a rental it might be making a profit by owning the works. The contract with the water company expires in four years. The committee believe that the only relief to the city is the passage of "a bill to supply the city of Oswego with pure and wholesome water," passed in the last N. Y. Legislature but not signed by the governor. They recommend a committee of three to push this bill in Albany. The recommendation was adopted.

A DEBATE occurred on January 29 in the Philadelphia Councils on the pollution of the Schuylkill water, and in this connection three resolutions were passed. The first was to prevent further permits being granted to connect closets with the sewers in the Twenty-first and Twenty-eighth Wards. Mr. Vanderslice said that 300,000 people were drinking this filthy water, and in consequence hundreds were dying weekly. Mr. McCoach averred that he neither wanted to pollute the water nor drink it; but he thought the pollution was mainly confined to the coal districts. The second resolution provided for the institution of legal proceedings against persons dumping refuse into the river, and the third requested the trustees of the gasworks to prevent any of their refuse going into the river at Manayunk.

THE construction company which had the contract for building the city water-works at Grand Haven, Mich., and rent its hydrants, seventy in number, to the city at the rate of $60 per hydrant per year, for twenty consecutive years, has finished its work. The company, in its contract, stipulated to furnish pure well-water to the city, and guaranteed upon testing the hydrants to throw six consecutive streams one hundred feet high, all of which proved a great failure, in the presence of the Grand Haven city fathers. The well reservoirs were pumped dry within fifteen minutes, and river water had to be resorted to keep up a stream, while the six guaranteed streams did not reach a height exceeding fifty feet, and three streams were tried which attained a height not exceeding sixty feet. At this juncture a stream from a hydrant belonging to the old city works was turned on to make a comparison, which beat the new works.—*Exchange.*

THE Schuylkill Water Storage, Water Supply and Water Power Co. have been trying to get a charter at Harrisburg, Pa., but the Governor refused to grant it on the ground that the charter already held by the South Mt. Water Co. precluded another. The first named company proposed the building of a dam across the Schuylkill at Flat Rock, just above Philadelphia, and the flooding of the valley back to Reading, Pa. This dam, if built, would flood part of Norristown and other large towns, overwhelm the Reading and Pennsylvania R. R. tracks, the Schuylkill Canal, etc., etc. Rather an astonishing proposition. Consequential damages and stock capital of the proposed company are not given.

NEWS OF THE WEEK.

Miscellaneous.

New Florida Hotel.—A new hotel of 200 rooms is to be built in Palatka, Florida. It is to cost $100,000.

Electric Head-light.—The American Electric Headlight Company has just placed one of its lamps on engine No. 460, on the C. St. L. & P. R. R.

New Cable Road.—Mr. Henry Martin, is forming a company to run a cable road from the center of Cincinnati to Mount Auburn, by the Way of Sycamore Street Hill.

The Cataracts of the Nile, are due to granite veins which the river, while working its way through the sandstone, had been unable to destroy or remove.

Sleighs instead of Horse Cars.—The City Engineer of Toronto, has notified the Street Railway Co., to withdraw their wheeled vehicles, and at once substitute sleighs.

The Chicago Public Library is said to be in a dangerous condition. Too many books and too much weight on weak floors is the cause given.

The Globe Panorama Co.—is about to build a $45,000 building in St. Louis. It will contain among other attractions the "Seige of Paris"--lately exhibited in the East.

Ditching Co.—The National Ditching Machine Company at Chicago was incorporated on Jan. 26, capital stock, $100,000. Incorporators—Thos. A. Humphreville, H. B. Prosser and Geo. W. Wilson.

Rich Enough.—The estate of the late John W. Garrett, of the B. & O. system, is said to foot up to $35,000,000. It is chiefly invested in the Balt. and Ohio R. R. and its branches.

The Basic Process.—The *Newcastle Chronicle* quotes the following as the number of converters used or to be used in producing steel on the basic process in the countries named: Great Britain, 19; Germany, 41; Austria, 7; France, 13; Belgium, 4; Russia, 2; United States, 2; Total, 88.

The Charleston Harbor Jetties.—CHARLESTON, S. C. January 23.—Gen. Gillmore, of the United States army, expresses his entire satisfaction with the progress of the work on the National jetties in this harbor, and says he is confident that a navigable channel 30 feet deep across the bar can be easily made and maintained.

Natural Gas in Kansas City.—Kansas City, Mo., Jan 30.—The City Council passed an ordinance to-night granting to Pittsburg, Pa., and Kansas City parties the right to lay mains for the utilization of natural gas from wells which have been sunk in West Kansas City. The gas will be used for heating and manufacturing, and it is claimed will be the means of bringing important manufacturing interests here from the East.

Money Wanted for Treasury Vaults.—WASHINGTON, January 27.—Secretary McCulloch to-day addressed a communication to the speaker of the house of representatives, recommending an appropriation of $500,000 for the construction of an additional vault for the storage of silver, and for expenses attending the transfer of silver from the sub-treasuries, which are now, and which may become overcrowded with that coin.

Chicago Public Work.--The total cost of the street improvements of Chicago, ordered by the Council for the present year has been roughly estimated at $3,000,000, of which the city's portion would be about $600,000. But quite a number of street ordinances since their passage have been either repealed or suspended, and it is quite likely that the amount will be reduced to $2,000,000 by the time the Council and the Controller get through with paring down the estimates.

Bills has been introduced into the Nebraska Legislature.

Providing for the erection of two buildings on the University grounds in Lincoln for the industrial and scientific departments of the University, and appropriating $75,000 therefor.

Establishing Northern hospital for insane at Norfolk (providing the city donate 40 acres of ground for a site), and appropriating $30,000 for its construction.

Minnesota Bridges.—Bills were introduced into the Minnesota Legislature, January 24th to January 30th, appropriating amounts as follows:—

$400 to build a bridge across the ten-mile creek in Martin county.

$800 to build a bridge in Paineville, in Stearns county.

$500 to bridge Rush creek, in Winona county.

$600 to aid the town of Nelson to build a bridge across the north branch of the Watonwan river.

$900 to aid the county of Renville to build bridges across Beaver and Birch Coolie creeks and to grade a town line.

A bill authorizing Pine county to issue bonds to build a court house at Pine City.

A bill authorizing Wright county to issue $10,000 bonds to build a bridge, reported on favorably and passed.

$800 to bridge the Des Moines river in Cottonwood county also passed in Senate Jan. 28th.

A bill to authorize the town of St. Josephs to issue bonds to build a bridge; passed.

$500 to bridge the Jo river, in Kittson county.

$900 to bridge Rock river in Pipestone county.

$800 to bridge the Leaf river in Otter Tail county.

$300 to bridge the Lac Qui Parle river.

A petition was presented for a bridge across Crow river to McLeod County. The petition asked for $1,000, the county to meet the balance of expense.

$6000 to build a bridge over Mud creek, in Sibley county.

A bill to appropriate money, amount not stated, for bridges in Douglas county.

$1,500 to widen and deepen Lime creek in Freeborn county.

$2,000 to bridge Spring Lake in Katota. $2,500 to bridge Slate river in Todd county.

$3,500 to bridge the Zumbro river, in Goodhue county.

A bill to authorize Meeker county to issue $7,000 bonds to build a court-house. Passed.

$800 to bridge the Chippewa river, in Chippewa county.

$1,000 to bridge the Sauk river, in Stearns county.

$3,000 to bridge the Cannon river in Dakota county.

$2,500 to bridge the Snake river in Pine county.

Still after that money. Mr. Boardman presented the petition of Walter Shanly for $129,495.62 for loss of money under the Hoosac tunnel contract, to the Massachusetts Legislature lately. He sets forth the circumstances of the loss and of the contract, reviews the action of the Legislature, and calls attention to the fact that in 1881 the claims committee reported unanimously in his favor to the amount of $79,495.12.

Horses and Street Paving in Berlin.—Boston *Advertiser*: The City of Berlin, Germany, contains, all told, 27,000 horses. Every horse in Germany is registered, so that the number is known. The owners of 15,000 of the 27,000 horses in Berlin have petitioned the authorities to continue the work of paving the streets with asphalt. The petition is in reply to an opposition to asphalt pavements made by the cab drivers' organization. The cabmen made the usual charge against asphalt; but it was shown that it was their interest to have poor pavements and muddy streets, as tending to increase their custom; while the other owner of horses especially owners of private carriages, are enthusiastic in favor of asphalt pavements.

Coolie Labor in Peru.—The Peruvian Commissioner Senor Lauri, has signed a contract for the establishment of a line of steamers between China and Peru, and the initiation of a stream of immigration which shall enable farmers and miners to resume work, now almost abandoned, owing to the scarcity of labor—a scarcity which has resulted from protracted war and anarchy.

Lauri has succeeded in his mission, and has signed a contract with some leading San Francisco houses, which, if approved by the Government of Peru and China, will be at once carried into effect. In drafting this contract attention has been paid to the fact that Chinese laborers in Peru in past times have been harshly treated. Ample provision is made for their defense and protection, this duty being placed in the hands of four Chinese benevolent societies of San Francisco. The system of sale is abolished, and planters, who in former times had to pay out $200 or $300 to labor contractors, will now only have to pay £15 to the steamship company. Wages of laborers are stipulated at from 60 cents to 65 cents per day, and they can break their contract, which is for five years, at any moment they please by returning £3 for each unlapsed year.

Water Versus Rail Routes.—The annual report of the operationn of the New York canals for 1884 shows that the total amount of freight moved during the season was 5,009,448 tons, or 654,588 tons less than was moved on the canals in 1883. Of the freight moved last year the products of the forest aggregated 1,671,705 tons; of agriculture, 1,264,237 tons; of manufacture, 205,006 tons; merchandise, 300,450 tons, and other articles, 1,568,059 tons. Not only was the volume of freight diminished, but the rates were unprecedentedly low, canal business suffering in common with railroads. The reported operations of the New York Central railroad for 1884 show 688,024, tons less freight than in 1883, and of the Erie 2,538,685 tons less. The aggregate annual tonnage of all lines competing with the canals was 22,123,895. The average rate of canal freight for 1884 was .27 of a cent per ton per mile against .340 of a cent per ton in 1883. The average rate of freight on the railroads for all classes of articles shipped in 1884 was .740 of a cent per ton per mile against .845 of a cent per ton in 1883.

Against the Dynamitards.—Boston, Mass., January 27.—In the senate to-day Mr. Thayer introduced a bill providing for the punishment of persons making, selling, offering to sell, or having in their possession nitroglycerine, giant powder, or any other explosive compound with intent that such explosives shall be used at any place within the Commonwealth, or in any foreign country, for the injury or destruction of public or private property or for the purpose of assassination. The penalty attached to the bills for violation of its provisions is imprisonment in the State Prison for a term not exceeding ten years, or in the County Jail not exceeding three years, or by fine exceeding $500. The bill further provides for the punishment of all persons aiding or abetting the manufacture, sale or transportation of explosives, knowing the same to be used for the purposes named above. The bill was referred to the Committee on Judiciary.

Improving the Wabash River.—VINCENNES, IND., January 26.—The river and harbor bill appropriates $50,000 for the improvement of the Wabash River, $10,000 of which is to be spent above Vincennes for the improvement of the river, and $40,000 below Vincennes and about the Grand Rapids dam, twenty-one miles south of this city. Probably a greater part of this amount will be applied to the improvement of the lock and dam. The contract for furnishing the cut stone for this lock and dam has just been awarded to a firm of Pennsylvania and Washington City gentlemen. The contract calls for 7,000 cubic yards of dressed stone, to be delivered at the rapids. The contract price is $30,000 and the appropriation for that much of the work is now available. The work will require first-class stone, and will probably be secured from Lawrence County, Ind., or at some of the quarries on the Air Line Railroad, between Huntingburg and New Albany. The contractors are already preparing to commence the work, and a large number of Italian stonecutters have been engaged. The whole work will cost, it is estimated, $135,000.

Natural Gas Well at Toronto.—Toronto, Ont., January 31.—A powerful flow of natural gas has been struck by a well sunk for the purpose near here, and it is hoped that the city may eventually be lighted from that source.

Railroads, Bridges and Canals.

The **Bee Line** people propose the present year to introduce railroad signals on their lines at railroad crossings much more extensively.

The **Warsaw Mining and Railroad Co.**, is to be incorporated at the present session of the North Carolina Legislature.

The **South Penna. R. R.** is reducing its tunnels to single track, and breaking up its grades to reduce expenses.

The **Bridge Works** of Lassig & Alden, Lake View, Chicago, were burned on Jan. 25. Insured for $70,000 loss much less than that.

New Bridge at Omaha.—Surveys and soundings are again being made for a bridge across the Missouri between Council Bluffs and Omaha.

The Councils of Cleveland, Ohio, recommend a bridge over Walworth Run at Pearl St. to cost $65,000. And the City Engineer says the Main St. Bridge should be rebuilt at an expense of $40,000.

The **Murfreesboro R. R. and Telegraph Co.** has applied for a charter to the North Carolina Legislature. It is to run from Boykin's Depot through Northampton, Hartford and Bertie Counties to some point on the Roanoke River.

A **Mexican Central** official denies the current story that they use wooden saints, stolen from the churches, for fuel on engines. He says it is cheaper to buy cordwood at $4.00 per cord than saints at 50cts. apiece, the price quoted.

The **St. Louis Air Line** is contemplating an extension of 78 miles from Mount Vernon, the present western terminus, to St. Louis. President French, of the Company, says the increasing freight business will warrant the expenditure.

Mortgage of over a Million.—DAYTON, O., Jan. 26.—The Dayton & Ironton Railroad to-day filed mortgages for record here for $1,700,000. The mortgages are given the Trust Company of Boston to secure bonds issued by the railroad which are payable in thirty-five years at 5 per cent. interest per annum.

Fort Worth and Denver R. R. Extension.—WICHITA FALLS, TEX., January 28th—The extension of the Fort Worth and Denver Railroad forty miles west of here is now certain and the material is arriving for the work. The company intend to complete the work in time for the spring drive, the middle of April.

Mexican Central R. R.—The rails on the Tampico Branch of the Mexican Central Railroad have been laid as far as Villa des Valles. In a (month's) time the rails will reach Abra de Caballero. Five tunnels have been completed in the difficult pass of Canon de Guerrero, and the road is being railed through the pass. Work has dragged somewhat during the past two weeks.

West Shore R. R.—On January 1, the West Shore Co. introduced Pennsylvania R. R. system of examination of employees. Thus far no employee has failed to reach the 85 per cent. standard required by the new "double order, single track rules."

Grades to rule rates.—A bill has been introduced in the Tennessee Legislature providing that when the ascent of a railroad is 1,000 feet in a mile every passenger can be charged 50 cents, and a charge for freight can be made at 8 cents per 100 pounds. This is to help out the project of a railroad up Lookout Mountain.

New Locomotives.—A large order for locomotives has been received by the Schenectady Locomotive Works from the Chicago & Northwestern railroad, and an additional force of men will be put to work next week. Edward Ellis, the treasurer, of the company, says that the order is sufficiently large to keep a big force employed until the grass is well grown.

Bills Before the Ontario Legislature.—To incorporate the Leamington and Belle River Railway Co.

To incorporate the Algoma Railway Company for a line from any point on the Sault Ste. Marie to the Victoria mine.

To incorporate a company to construct a railway from Brockville, by way of Merrickville, to Ottawa, etc.

To incorporate the Niagara Falls Railway Company to construct and operate, by electric or other power, a railway along the edge of the Niagara River from the Horshoe falls to Queenstown village; also various incline railways.

Pennsylvania and Pullman.—The new fifteen-year contract between the Pennsylvania Railroad and the Pullman Palace Car Company has not yet been signed, although the old agreement expired by limitation last month. The signing will, in all probability, take place towards the end of next week. Everything, save a few smaller details, has been agreed to, and next Wednesday the Board of Directors of the Pennsylvania will consider these. It is not thought that any objections will be urged against any of them by either party.

Winnipeg Railroads.—WINNIPEG, Man., Jan. 28th—The Manitoba southwestern branch, now built 50 miles from Winnipeg, will be extended another 100 miles this summer with the terminal at White Water Lake, and completed in time to move next year's crops. Contract for ties for the additional 50 miles on the Manitoba Northwestern now running to Minnedosa, has been let and trains will be running to Birtie by autumn.

Change of Headquarters.—It is said there is a strong probability that the general offices of the New York, Pennsylvania and Ohio at Cleveland are to be removed to New York and combined with those of the Erie in that city. By this arrangement and the placing of the Erie system under one management with a single set of officials, a saving of $50,000 a year would be effected.

Another Bridge Across the St. Lawrence.—Another railway bridge across the St. Lawrence, making three, including the Canadian Pacific's contemplated one at Lachine, is projected by the Ottawa, Waddington, and New York Railway Company, the site to be at Goose-neck island. The bridge over the main channel will be 1,160 feet long, and will be divided into four spans of from 200 to 250 feet, the third span from the south shore having a span of 250 feet, and a clear height above the river of forty-four feet.

Want to Build Bridges.—Galena, Ill., January 28.—The various towns in Wisconsin through which the Chicago, Freeport and St. Paul Railroad is to pass have voted aid to that enterprise to the amount of $200,000. A total sum of $400,000 is expected. The company have asked the Wisconsin Legislature for permission to build bridges over the Wisconsin River in Iowa and Sauk Counties, over the Kickapoo River and the West Branch, County of Vernon, over Lake St. Croix, across Chippewa River, and over Black River. Chief Engineer Baldwin and party have just completed the survey to St. Paul.

The Forth Bridge.—On the evening of January 1, one of the 70-feet diameter caissons filled with water and settled into the mud unequally, causing a tilting over to an angle of 25 degrees, and a sliding forward of about 15 feet. The plating had not been carried to the full height, so it will be necessary to fix a few plates by divers before the caisson can be pumped out and righted. About 3000 tons of concrete had been filled into the caisson over the roof of the compressed air working chamber, which weight was sufficient to keep the caisson from floating until about half-tide. The operation of sinking by the pneumatic process had not commenced, consequently there has been no risk of loss of life as first reported. As the caisson now stands, one edge of it is 5 feet below low water, and the other edge 20 feet above, so there will be little difficulty in adding the plates required, and pumping out the 2300 tons of water which now fills the caisson, and prevents it from floating.

Making Railway Travel Safe.—An apparatus has just been invented which is simply astounding, for with it the traveler need no longer fear any accidents. Safety will be assured on railroads. This apparatus permits the employe charged with the duty to see in a mirror the entire section of the road he is to control, with all the trains in motion, and he knows at every instant just exactly where each train is. When one of them approaches another at a distance which is dangerous he can immediately signal the menaced train. The apparatus consists of sheet of opaque glass, on which the rails are indicated by horizontal lines and the stations by vertical ones, numbered. Little arrows representing the trains, move along the horizontal lines. They are put in motion by aid of electricity, developed by the contact of metallic brushes attached to the locomotives with zinc bands placed along the rails. The train thus continually traces its trajectory on the glass indicator. The apparatus was exhibited some days ago in Germany to a commission of Berlin scientists.—*Paris Gaulois.*

A View of the West Shore.—In their annual report the New York Commissioners, speaking of the West Shore, in the first few lines says: "No railroad in the country has higher, and few as high, standards of roadbed and equipment. The road is by no means completed, but where finished the standards are strictly adhered to." As a general thing the road-bed is in a wonderfully good condition for so new a road. The difficult engineering works are spoken of and credit is given to Chief Engineer Katte and his corps of assistants for the successful way in which they overcame these difficulties. The condition of the road is reported as on October 11. The precise condition of tracks is as follows: One hundred and eighty-five miles laid and ballasted; 16.5 miles laid and half ballasted; 13.5 miles laid and not ballasted; 78 miles not laid at all. The fine machine shops at Frankfort are extensive, though not completed. There are others at Buffalo for less important repairs, also extensive freight and stock yards. The terminal facilities at Buffalo are not yet complete. It has 1,700 feet front on a strip between the City Ship Canal and the lake, where it proposes to erect an elevator when circumstances and business shall warrant. The equipment is all new and first-class in every respect but one; that is as to the heating and ventilation of the passenger coaches.

New Signals on the Cars.—The bell cord has been removed from nearly all the trains of the Pennsylvania Railroad, and a patent air tube system of signalling has been substituted. Each car has a rubber tube running under the bottom, and these are connected between the cars in the same way as the Westinghouse air brake tubes. They are kept charged with air at fifteen pounds pressure from a resservoir situated under the cab of the engine, and which is itself supplied from the air-break reservoir. The rubber tube is also connected with a whistle valve in the engineer's cab. The conductor by pulling a cord in the car opens a valve in the rubber tube and allows the air to escape. This relieves the pressure on the whistle valve and throws it open, causing the whistle to sound. So long as the cord is held the whistle will sound. One whistle means the train is broken. The same effect would be caused if the rubber tube was broken, and the engine would thus be informed at once of the accident.

The new device is not popular among the trainmen; but, although it is very costly, the officers of the road are substituting it for the bell rope. The fault of the bell rope is that it is apt to get too slack or to get broker. The air signal will also be placed on the West Jersey, Camden and Atlantic Railroads and other roads controlled by the Pennsylvania Railroad.—[*New York Sun.*

Contracting.

A New Court House is asked for by the citizens of Butler Co. Ohio.

A New Theatre.—Nashville, Tenn. wants to build a new theatre from plans of N. Y. architect, to cost $70,000.

New Insane Asylum.—The Tennessee Legislature on Jan. 29th passed a bill to spend $85,000 in building an insane asylum at Jackson.

Cincinnati Sewers.—Cincinnati Councils on Feb. 1st, recommended the construction of certain sewers; to cost property owners $56,800, the city, $74,338.

New Depot.—The Air-line Company contemplate the erection of a new and handsome passenger depot at Boonville, Ind., in the near future.

The Federal Building, Chicago.—John Cox, a Chicago builder, has received the contract for building the concrete foundation for the new Federal building. His bid of $5,471 was the lowest.

Ohio Building Notes.—The Ohio Legislature has before it bills as follows: to erect a Town Hall for Wellington Twn., Lorain Co.; to erect a Town Hall in Columbia Twn., Hamilton Co.; to authorize Ashland Co. to borrow $30,000 for a jail and sheriff's house.

Denver Court House.—The contract for constructing the basement and area walls of the court house, etc., at Denver, Colo., has been awarded to Messrs. Hayes & McGilvray, of Denver, Colo., at their bid of $19,880.

$1,500,000 for Buildings.—It is reported that Messrs. Flood and Mackay have decided to erect two business blocks on their lots at both the corners of Market and Fourth streets, each costing in the neighborhood of $1,500,000. Work will be begun in the Spring. —San Francisco *Chronicle.*

Extension of Sea Wall.—Bids will be received until February 17th, at the office of the Health Commissioners No. 301 Mott Street New York, for Extension of Sea Wall on North Brother Island in the East River. For particulars see *City Record.*

Horace E. Horton.—A well known bridge contractor, of Rochester, Minn., completed a five span combination bridge across Chippewa River, at Chippewa Falls, Wis., on the 27th ult., and in the same day the bridge was accepted and paid for, (price $25,000) by the County Board.

Public Building at Columbia, O.—The Architect of the Treasury recommended an additional appropriation of $60,000 for the public building at Columbus, Ohio, and $45,000 for the building at Des Moines, Iowa. He also recommends that the limit of appropriation for the public building at St. Louis be increased to $350,000.

Salem Work.—The Common Council of Salem, Mass. passed to a second reading, on Jan. 26, an order to appropriate $125,000 for filling North river flats and building a canal 60 feet wide from Dean street, to deep water below North bridge. The plan provides for a plank bulkhead and a dredged channel. There was very considerable opposition against the order before its passage.

Stone and Brick Work, etc., at Erie, Pa.—Sealed proposals will be received at the office of Supervising Architect, Washington, until 2 P. M., on the 28th day of February, 1885, for furnishing and setting all the stone and brick work for the superstructure of the court house, post office, etc., at Erie, Pa., in accordance with specifications and drawings, at that office or the office of the local Superintendent of the building.

Bills Passed.—Following Bills were passed by the lower house of the Dakota Legislature, appropriating amounts as stated for permanent improvements:—

$25,000 for the school of deaf mutes at Sioux Falls.
$18,500 for Vermillion University.
$20,000 for agricultural college at Brookings.
$14,000 for the normal school at Madison.

Building in Brooklyn.—During 1884, 2,739 new buildings were erected in Brooklyn at a cost of $12,672,334. In 1883 the number was 2,800.

Stone and Brick Work at Lynchburg, Va.—Sealed proposals will be received at the office of Supervising Architect, Washington, until 2 P. M., on the 26th day of February, 1885, for furnishing the labor and material, brick, terra cotta, stone, mortar, etc., and building complete the masonry of the walls of basement and superstructure of the court house, post office, etc., building at Lynchburg, Va., in accordance with drawings and specifications, at that office or the office of the Superintendent.

Chicago Water Pipes.—Bids were opened on Jan. 14th in the Department of Public Works, Chicago, for water pipes of from six to twenty-four inches in diameter. The whole quantity the city will use is estimated at 3,000 tons. The lowest bid was made by the Lake Shore Foundry Company of Cleveland, Ohio, which will be awarded the contract at prices ranging from $24.50 to $25.50 per ton. The pipe has to be delivered at the yard of the West Side Pumping Works.

After a Fat Contract.—John J. O'Brien and Barney Bigiln, the Republican local leaders, have gone to Washington to make an determined effort to get the contract for weighing the goods handled at the custom house. This work used to be farmed out by the Government. Albert Daggett held the contract until two years ago, and is reported to have made from $80,000 to $100,000 a year out of it. Then the Treasury Department undertook to hire laborers and do the work itself. Since then, Collector Roberston says, the Government has saved about $100,000 a year.—*N. Y. Herald.*

Bridge Bids.—Bids received for Wrought-Iron Swing Bridge Jan. 3d at Chillicothe, Ohio.

King Bridge Co. Cleveland, O	1150.00
Chillicothe F & M. Works, Chillicothe, O	1075.00
Mt. Vernon Bridge Co. Mt. Vernon, O. Plan A.	875.00
" " " " (informal) " B.	680.00
Smith Bridge Co. Toledo, O	825.00

The contract was awarded by the City Council, to the Smith Bridge Co.

The City Council has contract for seventy (70) arc electric lamps 1200 C. P. each. Brush system to be used for street illumination in place of gas. Contract to go into effect March 1st.

Minneapolis Water Items.—On Jan. 30, the Minneapolis Water Board opened bids etc. as follows: For delivering water pipe during the coming season; Robingson & Mead, 57½ cts per ton E. Holmes,56 cts., F. B Hunt, 49 cts., and F. Young, sen. 44 cts, No award. R. D. Wood & Co. of Philadelphia, offered to furnish hydrants for 1885, at $49 each, on board cars at Minneapolis. The proposition was accepted to the limit of 200 hydrants. Bids for furnishing valves were then opened. James Walker & Co., of Detroit, offered to supply Eddy valves at the following prices:

	EACH.
Twenty-seven 6 inch valves at	$16 64
Twenty-eight 8 inch valves at	24 25
Two 10 inch valves at	32 36
Eleven 12 inch valves at	43 60
Four 16 inch valves at	81 16
Four 24 inch valves at	217 30

The Eddy valve company made indentical proposals. R. D. Wood & Co., of Philadelphia made the following figures also on Eddy valves.

Six inch	$16 72
Eight inch	24 00
Ten inch	33 00
Twelve inch	43 00
Sixteen inch	80 00
Twenty-four inch	219 00

The total of the bids made by James Walker & Co. was $2,866.44, and that of R. D. Wood & Co.'s bids was $2,863,94. The committee on construction was authorized to contract with the parties who, in their opinion, were entitled to the work.

Superintendent Henion presented some figures showing that these prices were much less than those of last year. At the prices named by Wood & Co. last season the valves needed this year would cost $3,405.10

Improving Gedney's Channel.—The following is an abstract of the bids opened by Colonel Gillespie for improving Gedney's Channel N. Y. H.:

Elijah Brainard, 20 Coentis slip, New York city, 57c. per cubic yard. Will use one scow with centrifugal pumps, the approximate daily capacity of which is 3,000 cubic yards. Will commence the work on the 1st of April and complete it by December 1. The width of the channel proportional to the price bid will be 800 feet, and the quantity of material as estimated by Colonel Gillespie which can be removed by the bidder under the available appropriation ($180,000) is 315,700 cubic yards.

Atlantic Dredging Company, Brooklyn, N. Y., 57c, per cubic yard. Will use four clamshell dredging machines, if so many can be worked to advantage, or if their use is found impracticable two self-loading machines, with a carrying capacity of 800 to 1,000 cubic yards per day; 315,700 cubic yards can be removed by this company for the available appropriation.

Morris & Cummings Dredging Company, New York, N. Y., 35c. per cubic yard. Will use one clamshell dredge and one or more centrifugal pump dredges, with suitable scows and tugs, with capacity of 700 to 1,000 cubic yards per day; 514,200 cubic yards of material can be removed by this bidder for available appropriation.

Ross & Sanford, Jersey City, N. J., 59 cents per cubic yard. Will use four powerful dredges, with capacity of 50,000 to 60,000 cubic yards per month; 305,000 cubic yards can be removed by this bidder for the available appropriation.

Roy Stone, 29 West Seventeenth street, New York for channel 200 feet wide, $60,000; for additional width of 200 feet, $80,000 for 200 feet of width more, $500 per foot of width; for widening 200 feet more, $550 per foot. Will use hydraulic plough and one steamer of not less than 500 horse power.

Contract awarded to Mr. Roy Stone.

The River and Harbor Bill.—WASHINGTON, Jan. 28.—Mr. McMillan, clerk to the senate commerce committee, has prepared an interesting analysis of the river and harbor bill as reported to the house last week, which shows how it is proposed to distribute the $11,250,000 appropriated by the bill. The following table gives the appropriates for each State and territory: Maine, 67,000; New Hampshire, 10,000; Vermont, 20,000; Massachusetts, 246,600; Rhode Island, 62,500; Connecticut,138,000; New York, 291,500; New Jersey, 200,000; Pennsylvania, 70,000; West Virginia, 275,400; Virginia, 261,000; North Carolina, 113,000; South Carolina, 179,500; Georgia, 293,000; Texas, 320,600; Ohio, 210,000; Ohio River, 350,000; Florida, 211,500; Alabama, 535,000; Louisiana, 207,000; Mississippi, 41,500; Arkansas,$70,000; Tennessee, 136,000; Kentucky, 231,000; Indiana, 97,500; Illinois, 521,000; Michigan, 436,700; Missouri, 70,000; Wisconsin, 208,500; Minnesota,46,500; Iowa, 70,000; California, 262,500; Oregon, 228,000; Washington territory, 14,000; Montana territory, 6,250; Dakota, 6,250; Maryland, 8,700; Delaware, 11,800; Mississippi river, 2,840,000; Missouri river, 540,000.

The Mississippi river appropriation foots up to $3,840,000, divided as follows:

Mississippi river snag boat Apper	$15,000
St. Paul to Des Moines	200,000
Reservoirs	250,000
Des Moines to Illinois river	200,000
Illinois river to Ohio river	400,000
Ohio river to gulf	2,800,000
Survey at passes	10,000
Survey service to gulf	75,000
Gauging lower river	5,000
Snag boat for lower river	50,000
Removing snags	50,000

Five hundred and forty thousand dollars is provided for the improvement of the Missouri river:

From the mouth to Sioux City	$350,000
Survey of the river	50,000
Removing snags	30,000
Ft. Leavenworth	10,000
Sioux City to Ft. Benton	100,000

The south secures for fifteen Southern States, $3,032,900:

Mississippi river, from Ohio to the gulf	$2,999,000
Half of the Ohio river	75,000
Total, $6,197,900	
The rest of the union, thirty-one States and territories	$2,230,800
Mississippi river, from the Ohio to head waters	850,000
Missouri river	540,000
Half of Ohio river	175,000
Total	$4,895,800
Potomac flats	150,000

The figures are exclusive of $500,000 since agreed upon for the harbor at Galveston, which will prove the most gigantic harbor improvement ever undertaken by any government.

Market Report of Engineering Materials.

New York, February 5, 1885.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer, and both the range of material and the market location will be extended as rapidly as possible. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.			
Angles	2.3c.	@	2.6c.
Tee	2.8c.	@	3c.
Beams and channels	3.0c.	@	3.5c.
Tank	2.2c.	@	2.3c.
Shell	2¾c.		
Steel plates, Tank	3c.	@	3½c.
WROUGHT-IRON PIPE,. PITTSBURGH.			
Butt welded, black, Discount	47½		
" " galvanized "	40		
Lap welded black "	67½		
" Galvanized "	50		
Boiler tubes "	60		
RAILS.			
Steel (large lots at mill)	$27	@	30
Old rails	16.50	@	17 50
R. R. spikes			2c.
R. R. splice-plates	1.65c.	@	1.75c.
R. R. Track Bolts	2¼c	@	2½c.
Barb-wire fencing, galvanized			5c.
" painted			4c.
Corrugated iron			
Nails.			
Iron	2.25		
Steel	2.25		

METALS.

COPPER.			
Lake Superior	11¾	@	.11¾
Other Brands	10¾	@	11
LEAD.			
Com. Domestic	3.60	@	3.70
Lead Pipe	.05¾		
Tin-Lined Lead Pipe	.15		
Sheet Lead	.06¾		
ZINC.			
Sheet	.05	@	05½

BRICK.

(Cargoes afloat)			
Haverstraw 1st per M.	$6.00	@	6.25
" 2nd "	5.62	@	5.87
Fishkill	4.75	@	5.50
Up-River			
Jerseys	5.25	@	6.00
Long Island			
" pale			
FRONTS.			
Croton red	14.00	@	
" dark	14.00	@	
" brown	12.00	@	
Philadelphia pressed	22.50	@	23.00
Trenton "	22.50	@	23.00
Baltimore "	37.00	@	41.00
Buff "	33.00	@	35.00
Enameled English	65.00	@	130.00
" American	85.00	@	120.00
Fire brick	25.00	@	40.00

CEMENT.

PORTLAND.			
Robins & Co., Extra English 425 lbs	2.75	@	2.90
K. B. & S. English 400 lbs	2.85	@	3.00
Burham " "	2.70	@	2.85
Rochester Castle " "	2.50	@	2.60
J. B. White & Bro. " "	2.50	@	2.60
Other brands, " "	2.40	@	2.50
Keene's fine " "	9.50	@	9.75
" course " "	5.25	@	5.50
Roman	2.75	@	3.50
Dyckerhoff, German 400 lbs	2.60	@	2.65
Star, " "	2.60	@	2.65
Alsen, " "	2.55	@	2.60
Hanover " "	2.40	@	2.50
Other brands, " "	2.35	@	2.40
Saylor's American	2.15	@	2.50
Rosendale cements	0.90	@	1.00

LIME.

Rockland common per bbl	1.00		
" finishing	1.20		
Glensfalls, common	.85		
" pointing	1.05	@	1.10
Kingston, ground	0.95		

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.90	@	95
" " No. 2 "	0.75	@	0.80
" " light drab "	0.80	@	0.95
Berlin " in rough "	0.75	@	1.00
Berea " " "	0.75	@	1.00
Brownstone, Portland, Ct. "	1 00	@	1.30
" Belleville, N. J. "	0.75	@	1.25
Granite, rough	0.60	@	1.25
Common building stone per load	2.00	@	3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40	@	3.00

SLATE.

Purple roofing per square	6.00	@	7.00
Green "	6.00	@	7.00
Red "	15.00		
Black Penna. (at New York) "	4.50	@	5.00

LUMBER.

PINE, Common box per M.	18.00	@	20.00
Good "	55.00	@	60.00
Tally plank, 1¼ in each.	.44	@	.50
Tally boards, dressed "	.28	@	.30
SPRUCE, Boards dressed "	.25	@	.28
Plank, 1¼ in "	.28	@	.30
" 2 in. "	.38	@	.40
" 2 in. dressed "	.43	@	.45
Timber per M.	20.00	@	22.00
HEMLOCK, Boards each.	.18	@	.20
Joist, 2¼ × 4 to 4 × 6 in	.17	@	.44
OAK per M.	55.00	@	65.00
CYPRESS 1, 1¼, 2 and 2¼ in "	35.00	@	40.00
YELLOW PINE, Girders "	26.00	@	35,00
Dressed flooring "	30.00	@	40.00
SHINGLES, Extra shaved pine, 18in. "			
" sawed " 18 in. "	4.50	@	5.00
LATH, Cargo rate	2.50	@	2.60

PAINT.

Lead, white, American dry per lb.	.04¾	@	.05
" " in oil pure "	.05½	@	.05¾
English, B. B. in oil "	.08½	@	.08¾
Red, American "	.05½	@	.05¾
Litharge "	.05	@	.05¼
Venetian red, American "	.01	@	.01¼
Indian red "	.05	@	.10
Vermillion, American lead "	.11	@	.11½
Paris green "	.15	@	.19
Umber, Amer. raw and powdered per lb.	.01½	@	.01½
Drop black, Amer. "	.08	@	.12
" " "	.09	@	.11½
Chrome green "	.05	@	.15
Oxide zinc, American "	.03¾	@	.04
" French "	.06¾	@	.06½

By arrangement between the French, German and Russian Governments a limited express, exactly similar to that run by the Pennsylvania Railroad between this city and Chicago, will be put on, on April 1 next, between Paris and St. Petersburg via Cologne, Berlin and Warsaw. The running time each way is to be fifty-six hours. The distance by rail ig 1276 miles.